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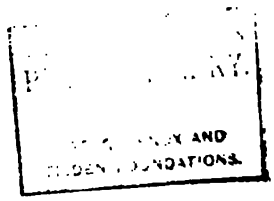
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STONE

VOLUME XVIII. DEEMBER, 1898. NUMBER 7.

CRUSHED QUARTZ AND ITS SOURCE.

THE numerous uses to which quartz, in its various forms may be put, fall naturally into three groups, according as to whether it is used in the natural state, or must previously undergo some process of sawing and cutting, or of crushing. Of the first group the best examples are the quartz sand used in the manufacture of glass and pottery, and the impalpable powder made up of the silicious remains of microscopic organisms, which is so extensively used for polishing purposes under the name of Tripoli. In the second group, the great number of quartz gems, and the more plebeian grindstones, whetstones and oilstones will serve as illustrations; while in the third group is found the powdered form of the mineral, so important as an abrasive. Its value in this line results from the sharp angularity of the minute grains formed by the process of crushing, and whether used for etching by the sand blast, or simply in the manufacture of our common sand paper, it is far more effective than the more rounded grains of the natural sands which are sometimes employed. The same is true, though to a lesser degree, in the processes of grinding and polishing employed in stone-working. In recent years there has also been a considerable annual output of quartz crystal, crushed to an impalpable powder, and used in wood finishing. On applying a mixture of powder and oil, the oil at once strikes into the pores of the wood, carrying the powder with it, and rendering it capable of taking a high polish.

The principal sources of quartz, as given in the Eighteenth Annual Report of the United States Geological Survey, are in Maryland, Maine, Connecticut and Massachusetts. To these should also be added New Hampshire, where considerable amounts are known to occur, and where its mining is carried on to a certain extent. The fact that little has been written

of the deposits of this state may serve to render the few facts here presented of some interest. The great abundance of quartz in comparison with the rather limited demand, combine to render its mining unprofitable except as incidental to the mining of the more valuable mica and feldspar with which it is almost universally associated in New Hampshire and elsewhere. These three minerals make up, essentially, the rock variously known as giant-granite, graphic-granite or pegmatite. The former name is, indeed, appropriate, for the crystallization of the minerals is on a gigantic scale Thus in the case of feldspar, crystals having a diameter of several feet are common, and in one instance a single, though imperfect, crystal having a diameter of nearly twenty feet was observed by the writer in one of the

MASS OF ROSE QUARTZ IN GIANT-GRANITE (PEGMATITE) NEAR OSGOOD'S LEDGE, ACWORTH, N. H.

giant-granites of New Hampshire. Likewise sheets of mica two and a half feet in diameter were observed, and it is said that a sheet from the old Ruggles mine at Grafton, now at Windsor Castle, England, measures 36x60 inches. It may be interesting to note in this connection that the first knowledge of mica in New Hampshire was in 1642, when Darley Field, an adventurous and highly imaginative Irishman, came home from a ramble through the then almost unknown White Mountains, with wild tales of the mountains and vivid descriptions of their riches including stories of immense plates of "muscovy glass" (mica) forty feet in length.

Unlike the feldspar and mica, the quartz does not occur in crystals. The giant granite of New Hampshire, like the common granite, is essentially an igneous rock, in which the mica and feldspar were the first to crystallize, while the quartz, being the last, was forced to content itself with the space the other two had left. It is for this reason that it occurs, not in a definite crystalline form, but in irregular masses of various shapes and sizes. These, however, are often far from insignificant in size, as the following list of some of the large masses of New Hampshire will show: Osgood's Ledge, Acworth, 50x45 ft; Silver Mt., Lempster, 60x12 ft; Crystal Mt., Lempster, 20x7 ft.; Beryl Mt., Acworth, 25 ft. wide and very long; Alger's Hill, Grafton, 25 ft. wide. A portion of one of these large masses is shown in illustration.

In some cases there has been insufficient quartz to entirely fill up the spaces left after the feldspar and mica have crystallized, and we then have open spaces or pockets remaining in the mass of the rock. Here, unlike the case in the more massive parts, we often find quartz crystals implanted upon the roof and sides of the pocket. A pocket of this sort at the Palermo mica mine, North Groton, was said by the superintendent to have been ten feet in diameter, and a quartz crystal over three feet in diameter which was taken from the roof of the pocket may be seen at the mine.

The quartz is usually clear milky white in color, but is sometimes characterized by a rich, though pale, rose color, as was the case of the mass which is here illustrated. The milky color is due to the presence of millions of microscopic cavities distributed throughout the mass. Sometimes cavities are visible to the eye and may have movable bubbles floating on the liquid filling them (water).

From a distance the giant-granite, especially where rich in quartz, (on which lichens do not gather), often presents the appearance of snow. Indeed in cases, the resemblance is so close that even one who is acquainted with this type of granite may, if in an unfamiliar locality, be unable to distinguish the difference at a distance of a mile or more.

The giant-granite from which the quartz is obtained occurs sometimes as dikes, sometimes as great lines between the strata, and sometimes as great irregular masses or *bosses* having no relation to the bedding of the inclosing rock. This inclosing rock is usually either granite or schistose, the latter being the most common and the giant-granite the most extensively developed in it. This was notably the case in New Hampshire. Its relations to the inclosing rock are essentially igneous in character, and it is closely related to the oridinary granite in origin. There is, however, one important difference, namely, the presence of water in the former while in a melted state. Impossible as it may seem, it has been proved by experiment that the presence of water in a highly-heated rock *aids fusion*, and

likewise helps the rock to remain molten much longer than would otherwise be the case. Thus in the giant-granite, the presence of water, combined with the great depth below the surface at which it hardened, tended to render the process of cooling a slow one, giving ample time for the growth of crystals of great size. The case illustrates how great a difference an apparently slight variation of composition may produce. The same molten mass which ordinarily produces our common fine-grained granite will, if a slight amount of water is present, form on cooling a rock in which the crystals are of gigantic proportions, and which in general aspect bears no resemblance to the former. The one furnishes our best building stone, the other is our chief supply of mica, feldspar andq uartz.

Boston, Mass. *Myron L Fuller.*

PUMICE STONE IN STORAGE BATTERIES.

IT has long been the desire of electricians to perfect a practical storage battery, but of all the different systems that have been devised since the days of Faure and Planté, each and all have presented internal infelicities which have prevented their coming into general use, much as they have been desired. The Germans, however, seem to have made a long step towards solving the problem of a practical storage battery, and one factory now in Germany turns out fifty tons of batteries per day. One of the most ingenious innovations in the storage cells has been the admixture of granulated pumice stone with the lead from which the storage plates are to be molded. The heat from the molten lead expands the air contained in the] pores of the pumice stone, and in this way an infinite number of cells are formed throughout mass of lead. The porosity thus obtained is so great that a plate 9x7½ inches will absord five and one-half ounces of water. If desired, the pumice stone can be removed at will, but as a matter of fact, being electrically inert, and as there is but 10 per cent. of solid matter, its presence is of little account either one way or the other. By this method an enormous range is available, both in the elements of weight and porosity. It is hoped that by the use of this spongy form of lead a return may be permitted to the earlier and simpler Planté type of cell, which of late has given way to the Faure system, in which the active material is mechanically applied to the plate. The new spongy cell has a large natural surface of "active material," whether the plates be thick or thin, and it is held with absolute security in the innumerable pockets of the body of the plate. The use of pumice stone is certainly a most ingenious application of means to an end.—Stonemason.

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THE ST. PAUL CABLE HOIST.

THE cable hoist conveyor plant, recently built by The Trenton Iron Company for the United States Government at St. Paul, possesses some novel features, and is such a radical departure from the existing methods that it cannot fail to be of interest to quarrymen and others who have heavy loads to handle. The distinguishing feature of this line is the absence of fall rope carriers, which have been necessary heretofore for supporting the hoisting rope. The functions of these fall rope carriers have been so fully set forth in the columns of this journal, and are so well known, that it will not be necessary to consider their construction and relative merits further than to say that the best of them are objectionable and a constant source of trouble. The arrangement of the St. Paul plant has practically solved the problem of dispensing with these, and marks an advance in the capabilities of lines of this class. This arrangement is fully covered by patents owned by The Trenton Iron Company, and is known by the names of the patentees (Louis E. Laurant and Edward E. Cherry) as the Laurent-Cherry System. An engine with two drums is required, as in other hoist conveyor plants of this class, one for operating the hoisting rope and the other the traversing rope, or a rope that moves the carriage. The hoisting rope in lines as heretofore constructed winds on an ordinary grooved drum, and is conducted directly through fall rope carriers and the carriage to the fall block, and the traversing rope which works in an endless circuit is operated by a drum with a shallow concave rim, or a rim with a groove semi-elliptic in shape in section. In the Laurent-Cherry System, however, both ropes are operated in endless circuits, and both drums therefore have elliptic grooved rims, the ropes being lapped a sufficient number of times about these to give the necessary frictional contact. The hoisting rope, starting with the end which is fastened to the fall block, after making the necessary number of laps about the sheaves in the carriage and fall block, is conducted to a sheave in the top of the tail tower, around this to a sheave in the top of the head tower, thence down to the engine drum and around this as many times as may be necessary, and thence around a take-up sheave, by means of which a uniform tension is maintained, and back to a point on the rope itself between the carriage and the tail tower, where it terminates, and is secured by a patented double swivel attachment. The rope thus makes what is practic-

ally an endless circuit to which a short piece is attached, but which in reality is simply an extension of the one end, some 200 or 300 feet long that leads to the fall block, or long enough to allow for the greatest vertical lift and yet not so long as to overbalance the unloaded fall block and prevent it descending In thus dispensing with fall rope carriers, the expense of maintaining these is not only obviated but it becomes practicable to move the carriage at double the speed of lines using fall rope carriers, so that the capacity to handle a certain amount of material in a given time is correspondingly increased.

GENERAL VIEW.

The St. Paul plant is used in the construction of what is known as Lock and Dam No. 2, which is one of a series of four designed for the improvement of navigation in the Mississippi River between Minneapolis and St. Paul by the United States Government under the direction of Major Frederick V. Abbot. The following notes are taken from a paper by Mr. R. D. Seymour, the engineer in charge of erection, read before the Western Society of Engineers, Sept. 8th 1898: The towers it will be observed from the accompanying il-

HEAD TOWER.

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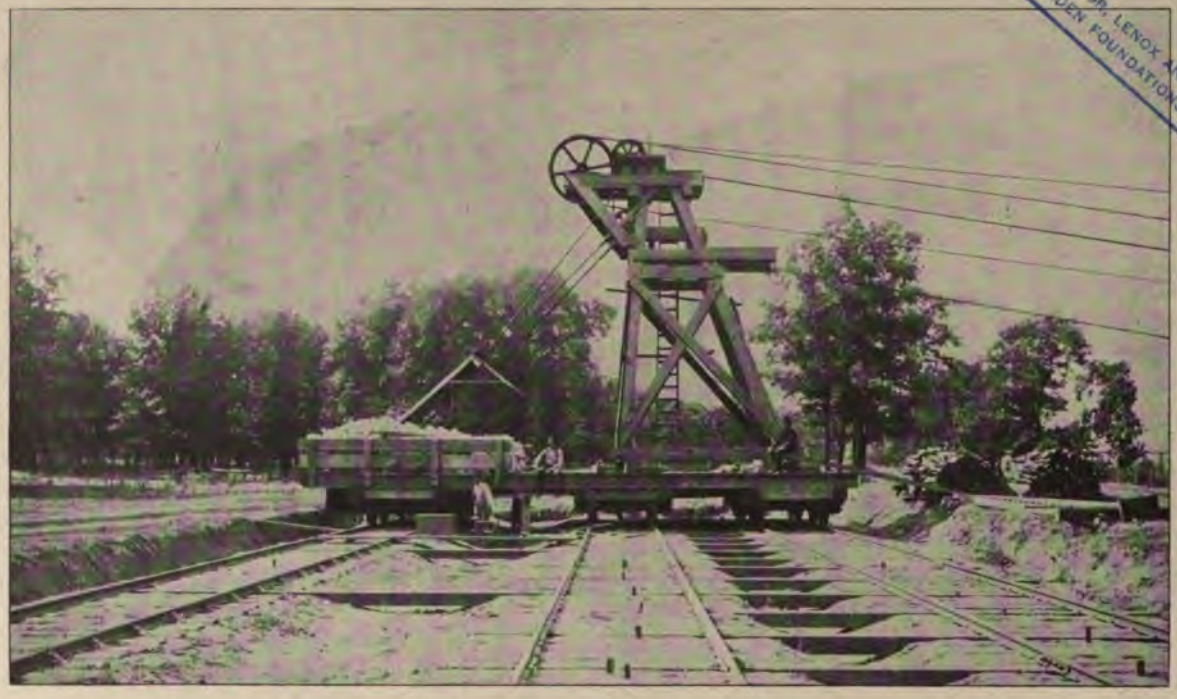


TAIL TOWER.

lustration are mounted upon trucks, so that the entire line can be shifted as the work progresses and is similar in this respect to the cable hoists used on the Chicago Drainage Canal. The clear span between the towers is 1,150 ft., the longest yet made with a movable plant. The head tower is 44 ft. in height above the rails, on which the trucks run, and the tail tower, owing to the difference of level in the banks of the river, but 30 ft. high. These towers and trucks are constructed in the most substantial manner of Oregon fir; the main posts being 12″x12″ and cross bracing and ties 3″x12″. The platforms of the trucks are made of 12″x12″ sills with 3″ plank spiked on, the platform of head tower measuring 56 ft. in length by 32 ft. in width, and the tail tower platform 42′x23′. These platforms are rigidly trussed with iron rods, those under the head tower upon which the engine rests being 1½″ in diameter. The tracks are laid with 63 pounds steel rails on cedar ties″ 18 apart, every fourth tie extending through, so as to preserve the relative distances apart of the tracks. The outside lines of rails are securely braced against the direction of the thrust.

The main cable is of the Patent Locked wire construction 2″ diameter and is anchored to the outer ends of the platform by adjustable tackles, one of the blocks of which shows in the view of the head tower. The reason for anchoring the cable in this way was owing to the fact that the loading was nearly all done in one place, and it was therefore stipulated in the specifications that the arrangement must be such that the cable could be shifted occasionally in order to distribute the wear at the loading place over as great a surface as possible. The line is operated by an engine with 10″x12″ double cylinders, rated at 50-H. P., and is capable of handling a five-ton load at a traversing speed of 800 ft. per minute; in fact it has been run at a speed of over 1,200 ft. per minute; without any appreciable vibration. The boiler used is of a pattern commonly known as the Scotch Marine, with internal fire-box, rated at 60-H. P.

The hoisting and hauling ropes are of cast steel, ¾″ diameter, 19 wires to the strand, of the ordinary lay; as these are not subjected to the abrasion caused by being run through fall rope carriers, the life of these ropes is greatly extended. The large sheave just back of the head timbers of the tail tower (see illustration) is one around which the hoisting rope passes. As the swivel connection has to pass around this sheave, it is made with specially wide flanges. In this particular case, however, the swivel connection would only touch this sheave when the carriage is within 200 ft. of the tail tower, which would be very seldom, as about 90 per cent. of the work to be done is in the middle of the span and near the East bank.

CONCRETE FACING ON A SANDSTONE BLUFF.*

THE line of the Chicago, Milwaukee & St. Paul Railway Company, in the city of St. Paul, beginning at the crossing of Chestnut street, extends with an ascending grade along the face of a bluff. This bluff is of a character common to the Mississippi River bluffs in that vicinity, and is composed of soft sandstone capped with an irregularly broken ledge of friable limestone, above which lie mixed together loose sand, gravel and boulders. This sandstone disintegrates readily, and is so soft that it wears away rapidly under the influence of the weather. The detritus from the bluff has frequently to be removed or it would cover the railway tracks, and the wearing away of the sandstone leaves the limestone ledge and the boulders which lie above it in a precarious condition, threatening the safety of the trains on the tracks below. From time to time it has been necessary to build masonry walls on the face of this bluff for the protection of the railway tracks. The photographs submitted with this paper show such masonry walls.

In the summer of 1897 it was decided to protect an additional stretch of the bluff, and the writer concluded to use a concrete facing instead of cut-stone masonry, for the reasons which follow:

He assumed that the stability of the sandstone would be secured if it were protected from the rain and frost, and that a facing of concrete or brickwork would furnish protection equal to that of cut-stone masonry at a saving in cost. He had a precedent for this in similar work that he had put in at Fort Snelling to support some dangerous projections of rock under similar conditions. At Fort Snelling the danger seemed imminent, and the overhanging rock was supported by brick buttresses or pilasters, and the adjacent bluff was covered with brick work to shed the water from it. The Fort Snelling work had been exposed for three years, and had served its purpose without signs of deterioration to the brickwork. At St. Paul he concluded that it would not be wise to make a smooth face to the bluff, because it would cost less to support the projecting limestone with pilasters than to remove it. If the projecting stone had been removed it would have resulted in loosening the adjacent stone, and the excavation would have ex-

*A paper read before the Western Society of Engineers September 7, 1898. Reprint from the Journal of the Society.

tended beyond the railway company's right of way into valuable city property.

A description of the work will be better understood by reference to the illustration.

In Fig. 1 the tracks shown in the foreground are those of the Chicago, St. Paul, Minneapolis and Omaha Railway Company, which are on the level bottom land at the foot of the bluff. The double track line of the Chicago, Milwaukee and St. Paul Railway Company lies on the bench which is supported by a retaining wall of stone masonry. At the left is shown a protecting wall of cut-stone masonry. In the background is shown the work under discussion at an early stage of its progress.

The loose material was removed from the face of the bluff, and the next operation was to build brick pilasters under the projecting limestone. Three of these pilasters were built, the one nearest to the left is 6′0″ wide and 4′3″ thick; the second one is 12′0″ wide and 4′9″ thick; and the third one is 6′0″ wide and 4′6″ thick. The dimensions of these pilasters give an indication of the sizes of the stone projections which they support. While the work was in progress, a heavy section of limestone, located some 200 feet from the left, tumbled down and temporarily obstructed the railway track, but its unstable condition was known, and there was nothing in the way to be injured by its fall. By reference to Fig. 2, it will be seen that projecting bricks are built into the pilasters near their inner corners, which bind the pilasters and the concrete facing together.

The foundation for pilasters and concrete facing is in the sandstone, four feet below the base of rail of the railway tracks, the footing course being two feet deep and ten inches wider than the wall above it.

The supporting frames for the concrete were put on in the following manner:

Bolts were put into the sandstone at distances apart of eight feet horizontally and vertically. With special augers holes were bored into the sandstone from four to five feet deep, inclining downwards so that the bolts would stand perpendicular to the face. The bolts were three-quarter inch in diameter and were placed in the holes with nuts on the lower ends, the holes being then filled around the bolts with mortar, a process easy of accomplishment on account of the downward inclination of the holes. The bolts projected about eighteen inches beyond the face of the sandstone with their ends terminating in cast iron nuts of cruciform section, and with the threads in the nuts long enough to engage a second section of three-quarter inch bolt. This second section of bolt held the uprights in place. The uprights consisted each of two planks 2x8 in section with the bolt passing between them. The planking supporting the concrete was placed against the inner edges of the uprights. This framework was built up in horizon-

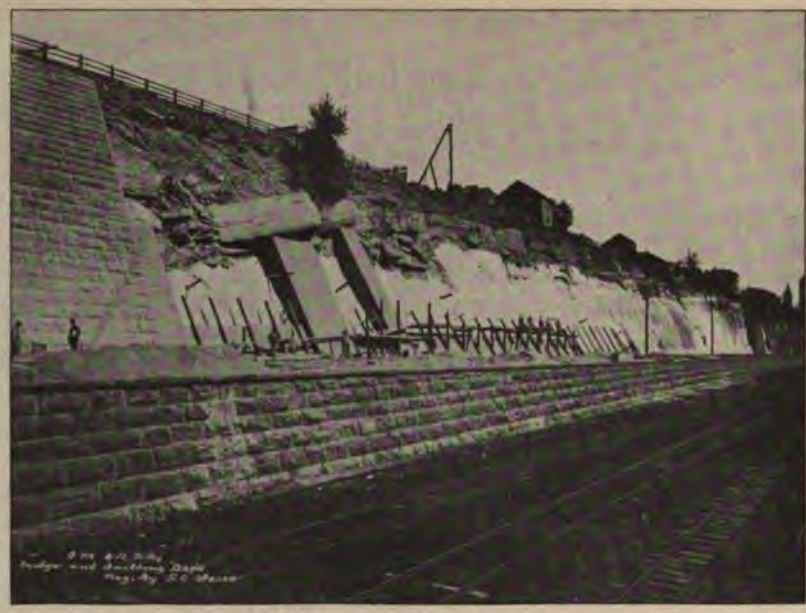


FIG. 1.—FACE OF BLUFF WITH BRICK PILASTERS IN POSITION.

FIG 2.—BROKEN LIMESTONE LEDGE SUPPORTED BY BRICK PILASTER.

tal sections, the uprights and planking used at the bottom being afterwards used again higher up on the wall. To remove the planking it was only necessary to unscrew the nuts which held the uprights, and when the concrete wall was exposed, the short ends of bolts were screwed out, leaving the wall securely bolted to the sandstone, and the bolt holes were then filled with mortar. It was not considered necessary that the concrete should be bolted to the sandstone, but the bolts were required to secure the concrete frames, and the easiest way to dispose of them was to uncouple and remove the short ends, and such value as they give in holding the concrete in place is gained without extra cost.

The method of bolting the frames to the bluff is shown in Fig. 3.

The work had to be carried on in the limited space between the railway tracks and the bluff. The sand for concrete was brought on cars and deposited outside of the tracks on the edge of the bench supporting them, as shown in Fig. 1. The broken stone was brought by team to the top of the bluff and dumped through a chute built against the stone wall, as shown in Fig. 2. The mixed concrete was deposited by wheelbarrows, using for the lower courses an inclined runway and later the wheelbarrows were hoisted by a derrick located on the bluff. This derrick is shown in Fig. 1. It was operated by steam, the engine being placed at the foot of the wall.

When the concrete wall was built up to the limestone ledge, all loose stone and dirt was removed, and the vacant spaces carefully filled with concrete. In some places where it was difficult to place the concrete, brickwork was used. Fig. 4 shows some of this brickwork located between the projecting pieces of limestone.

The concrete was continued from the top of the limestone ledge to the top of the bluff, and special care was taken to make the work tight at the top so that water would not get in behind the concrete.

The four engravings show the conditions in different stages and after the completion of the work, the finished work being represented by Fig. 4. No attempt was made to put in the concrete with a uniform slope, it being fitted against the formation of the bluff. This is plainly shown in Fig. 4, where a considerable depression or pocket appears at the left of the telegraph pole. The slope of the first pilaster is 11¼″ in 24″; of the second pilaster 12½″ in 24″; of the third pilaster 13½″ in 24″, while the slope of the concrete varies from 12½″ to 17″ in 24″, so that the general average slope of the work is approximately 1 horizontal to 2 vertical.

The brickwork was laid up with Milwaukee cement mortar except the exposed bricks, which were laid in Portland cement mortar. The concrete was made with 4 parts of Milwaukee cement to 6 parts of sand and 15 parts of broken stone; and was faced with 1½ inches of Portland cement mortar, composed of 1 of cement to 2 of sand. The mortar facing was placed

FIG. 3.—METHOD OF BUILDING FRAMES TO SUPPORT CONCRETE.

FIG. 4.—BLUFF PROTECTED BY CONCRETE FACING.

at the same time as the concrete, so that it set with it, making a perfect union. Western Portland cement made at Yankton, S. D., was used except for a small portion of the work, for which Empire Portland cement was supplied to make up a shortage of the Western.

The work was expensive on account of the limited space for working between the railway and the bluff, and the expensive nature of the concrete frames; but the cost per yard was less than if cut-stone masonry had been used, and the quantity of material in the wall was also less. If the work were to be done over again, the only change the writer would recommend is that concrete should be substituted for brick in the pilasters, as being equal in quality and costing less than the brick work. The work has been in place for a year and no faults appear in it. For similar work the thickness of the concrete facing, may in many cases be safely reduced. On sandstone of this class all that is required is that it should be protected from the weather, but care must be taken to prevent the water from getting in between the concrete and the sandstone. In the work described, the walls are thick enough to support the broken limestone, boulders and earth, as well as to prevent the sandstone from wearing away.

The following figures are taken from the records of the work:

DIMENSIONS.

Height of sandstone	30 ft.
Height of limestone ledge	12 ft.
Height of layer of sand, gravel and boulders	14 ft.
Height of wall above footing	56 ft.
Depth of footing	2 ft.
Length of wall	256 ft. 6 in.
Average thickness of brick pilasters	4 ft. 6 in.
Average thickness of concrete footing	3 ft. 3 in.
Average thickness of concrete facing below ledge	2 ft. 5 in.
Average thickness of concrete facing above ledge	3 ft. 2 in.

QUANTITIES.

Brick pilasters	141.5 cu. yds.	
Brick face wall	26.0 cu. yds.	
		167.5 cu. yds.
Concrete footing	61.2 cu. yds.	
Concrete face wall below limestone ledge	1038.5 cu. yds.	
Concrete face wall above limestone ledge	195.0 cu. yds.	
		1294.7 cu. yds.
Total brickwork and concrete		1462.2 cu. yds

COST.

Brickwork, labor $2.09; material, $2.91; total	$ 5.00 per cu. yd.
Concrete, labor $1.83; material, $2.32; total	4.15 per cu. yd.
Brickwork and concrete (average)	4.64 per cu. yd.
Brickwork and concrete (256'6") wall	26.46 per lin. ft.
Total cost of wall (256'6")	$6,787.36

Above cost covers all labor and material expended in preparing the

bluff to receive the wall; building the wall complete and removing all debris and waste material; and rebuilding fence after completion of work. It also includes engineering expense, but does not include freight charges on cement, sand and brick.

The work was done by the Bridge and Building Department of the Chicago, Milwaukee and St. Paul Railway Company, F. E. Rice being the engineer in direct charge. *Onward Bates, C. E.*

BUILDING AND WAGES IN NICE, FRANCE.

FROM the 1st of September, 1897, to the 1st of September, 1898, eighty new buildings have been erected in this city, at a cost of about 3,650,000 francs ($704,450), says United States Consul Van Buren, under date of October 13. These buildings consist of the usual medium-sized villas, the number of which is constantly increasing in the newer quarters of the town, and the usual apartment houses of four or five stories. All, without exception, are built of stone, the exteriors finished in plaster or cement, or, in a few cases, in stone.

The table gives scale of wages paid:

Workmen.	Wages.	
	Francs.	*U.S. Equivalent.*
Superintending mason.....per hour..	0.50	$0.096
Mason:		
First class.....do....	.48	.092
Second class.....do ...	.43	.082
Laborers.....do....	0.27 to .30	$0.052 to .057
Youths.....do....	.19	.036
Stone-cutters:		
First class.....do....	.70	.135
Second class.....do....	.60	.115
Superintending carpenter.....do....	1.05	.202
Carpenter:		
First class.....do....	0.80	0.154
Second class.....do....	.55	.106
Plasterer:		
First class.....do....	.81	.156
Second class.....do....	.58	.112
Apprentice.....do....	.29	.056
Marble cutters (10 hours per day).....per day..	6.00	1.158
Marble polishers (10 hours per day).....do....	5.00	.965

PRACTICAL STONE-CUTTING.—XIII.

EXPLANATION OF THE TANGENT SYSTEM BY MEANS OF WHICH THE BED AND JOINT SECTIONS MAY BE DEVELOPED, TOGETHER WITH DIRECTIONS, ETC., SHOWING THEIR APPLICATION IN PRACTICE AT THE BANKER, AS REQUIRED IN ORDER TO BRING THE STONES TO THE SHAPE DESIRED AT A RAIL OR COPING, THE PLAN OF WHICH IS A QUARTER CIRCLE THE RISE OR INCLINATION OF THE COPING PLACED OVER ONE TANGENT. THE COPING AT THE LOWER JOINT SURFACE TO MEET A LEVEL, AT THE UPPER JOINT SURFACE TO JOINT AGAINST AN INCLINED PIECE OF STRAIGHT COPING.

WITH the diagrams presented at this plate are commenced a series of drawings and explanations, dealing with work of a practical nature, and the problems introduced are for the most part copies of work already constructed. Rules will be given by means of which the necessary patterns may be developed, and the stones worked to their desired shape at the banker, so that the student may (if he so desires) be enabled to cut models of each problem and so get a thorough practical knowledge of the methods here employed and explained.

It is our intention at each example to explain. Firstly: The projection of the patterns, etc., by the methods as taught by the writers of the tangent system school. Secondly: The "Prismoidal" system, or the system adopted by the author for the same problem; the students will in this manner have the two systems presented side by side, and the practical readers will readily see the superiority of the latter over that of the former, as regards both the time saved in the cutting, and in the quantity of stock required out of which to form the twisted coping. We have, of course, at this beginning taken a very simple problem, the description of which is given above; it, as may be noticed, is a problem similar to that presented at Plate 2—Figs. 4—7: Plate 4, Figs. 1—4: Plate 6A, Figs. 1—8; and Plate 6 Figs. 1—5, to which plates we shall have occasion to refer our readers.

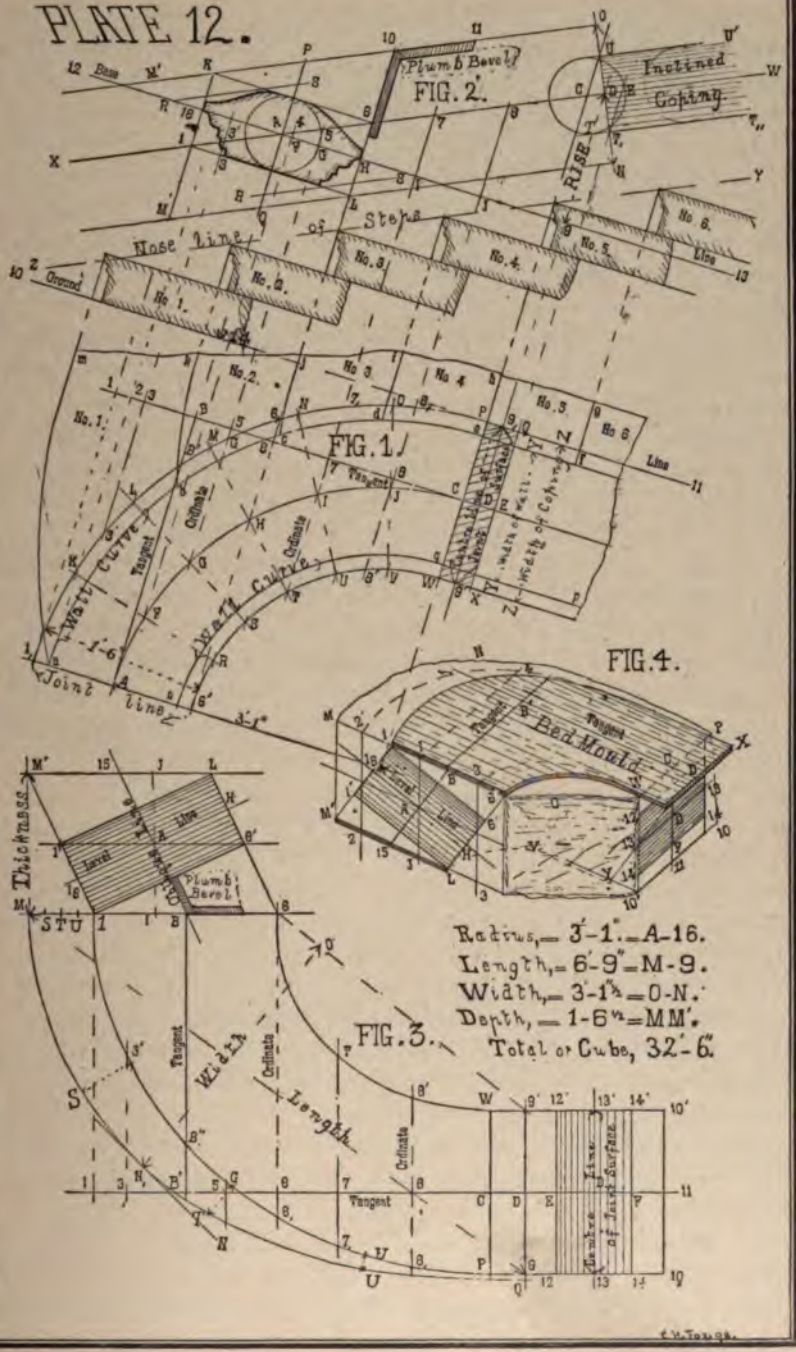
At this drawing the plan is given in Fig. 1, A—H—C represents the center; 1,—6,—P the convex: and 6′—T—W the concave curves of the coping. As may be noted, the coping projects a distance 1,—A, and N—6′ respectively, outside of the convex a—b—c. and concave face curve N—

*Copyrighted, 1897, by Chas. H. Fox.

Q of the wall. The plan of the steps are given in a—m—k—b, etc., and the elevation of the same in Nos. 1 to 6, Fig. 2. This is the section obtained at a vertical place parallel with that of the tangent plane whose Hor-trace is given in C—B Fig. 1. This tangent plane as we have shown in the construction of the cardboard model, explained in detail at Plate 6, is the one which contains the full inclination of the section plane upon which the bed mould may be projected. At this problem X—A—D of Fig. 2, parallel with Z—Y the nose line of the steps is taken to represent the full inclination of the section plane. This however is not a compulsory condition, that is, the inclination of section plane does not of necessity have to be parallel with the nose line of the steps, the inclination may be placed at any desired angle to suit the rise of the coping. Understanding this: Project A of Fig. 1 into A of Fig. 2, this becomes a fixed point and determines the height as 14—A of the center point of the level coping above the ground line 10—11. Now parallel with the ground line through A draw the base line 12—13. Then with the base line as a center line and A as the center, trace the joint section of the coping, and if a moulded one inclose it within the rectangle as shown in 1—K—6—L of Fig. 2. Then parallel with X—A—D through K—L, draw K—0, and L—N. At the upper joint surface, the coping joints against a straight piece inclined at an angle corresponding to that of X—A—D. We may again remark this is not a compulsory condition, as the coping in many cases meets at the joint surface in question a "ramp" piece which may connect the twisted with a "level" piece; but in either case the joint surface is cut at right angles with the inclined plane whose trace is given in X—A—D of Fig. 2.

Now project C of Fig. 1 into C of Fig. 2, and produce it as shown in U; then with C as a center and the half thickness of the coping as the radius draw an arc U—T; then parallel with X—D produce U—U′ and T—T′. This gives the elevation of the inclined coping. Now through U square with X—D draw O—N; this gives the elevation of the joint surface, and O—W, etc., and O—N is the thickness required of the rough stone out of which the twisted piece may be formed. Now projecting D—T′ into D—E of Fig. 1, the plan of the joint surface may be obtained. We may here remark: In general the point C is taken as the center point of the joint surface, but this necessitates the cutting of a portion of the curve upon the piece of straight coping which may meet the twisted piece. In adopting the method just shown, this is obviated, and the inclined piece may be worked with perfectly "straight faces." Now notice point 9 at the base line at which the vertical D—D intersects it. This determines in 9—D the vertical rise of the coping; that is, the coping in going around its curved plan rises a vertical height equal to that given in 9—D. Now projecting F—G, etc., of the plan into F—G, etc., of Fig. 2, the face, bed,

PLATE 12.


Plumb Bevel
FIG. 2.
Inclined Coping
RISE
Nose line of Steps
No. 1.
No. 2.
No. 3
No. 4.
No. 5.
No. 6.
Ground Line
FIG. 1.
Joint line
Tangent
Ordinate
Width of Coping
Width of Bed Mould
Bed Mould
FIG. 4.
Thickness
Plumb Bevel
Width
Length
Tangent
Ordinate
Centre line of Joint Surface
FIG. 3.
Radius,— 3'-1"=A-16.
Length,= 6'-9"=M-9.
Width,— 3'-1½=O-N.
Depth,— 1-6½=MM'.
Total or Cube, 32'-6"

and joint moulds may be projected by the methods fully explained for the like operations at Plates 6—6A. In Fig. 3 is shown the developed bed mould, together with that of the joint moulds placed into their relative positions at the joint lines Q—9 of the upper, and 1—6 of the lower. The position of the lower joint mould may be found as follows: At point B apply the plumb bevel 6—10—11 of Fig. 2, and set off B—A—15 equal with P—A—Q of Fig. 2, then through A square with B—15 draw 16—H, which gives the position of the level line passing through the center point A of the joint. Now trace the rectangle 1—1′—L—6 equal with that of 1—K—L—6 of Fig. 2, and through L draw L—M parallel with the joint line 6—1, this line if drawing is correct will pass through point given in 15; and if the side L—6′ be produced it will meet the joint line in point 6; Now to ascertain the size required of the rough stone out of which to form the coping: Having produced the plumb side 1—1′ as shown to M′, square with 6—M draw M′—M, then divide 1—M into any number of equal parts as shown in 1—U—T—S, etc., then divide the convex curve 1—3—9, of the bed mould into a similar number of equal parts that 1—M may have been divided; set off 3′—S: G—T, etc., equal with 1—S, 1—T, etc., and place pins into points given in M—S—T, etc., and then bend around them a flexible strip and trace a curve as shown. Now draw the chord lines 6—9′, and parallel with it a line as N_1—N to touch the curve just traced. This gives in O—N_1 the width; in 9—M the length; and in M--M′ the thickness required of the rough stone. If we take the width of coping as 1′—6″, length of radius 16—A with which the center line of the plan may be drawn, as 3′—1″, then with a scale of equal parts M—9 will measure 6′—9″; O—N″ 3′—1″½; and M—M′ 1′—6″½. Cubic contents of stone equals 32 ft. 6 inches.

Now to work the stone: Cut top surface straight and "out of wind." Apply bed mould and mark on stone the direction given by the joint line 6—1, and transfer the tangent line A—E. Cut the lower joint surface square with top: Mark on the joint mould as given in 6—L—M—1 of Fig. 3. Then square with the top surface draw through A, a line as I—J of Fig. 4. Then at the point given in I square with tangent line B—E draw I—4 of Fig. 4. This gives the direction at which to apply the bed mould in order to obtain the proper direction of the cutting line of the upper joint surface. The bed mould must now be applied in such a manner that the tangents on its surface are exactly over the lines I—4; and B—D already transferred to the surface of the stone. In this position mark on the joint line 9—9′ of the mould. Then cut the joint surface square with the top surface and to direction given by joint line: Then mark on the joint mould as given in 9—12—13—14—10′ etc., of Fig. 3. Then parallel with I—4 draw B—B′, this gives the direction at which to apply the bed mould in order to obtain

the direction at which to form the plumb cylindrical sides of the coping. Now at the top surface in the manner shown in Fig. 4, apply the bed mould having the tangents on its surface exactly over the lines B—B′, B′—D, and mark on the curves, this completes direction required at top surface. Lines drawn through 15 and 11, "out of wind" with B—B′, B′—D, will give at the lower surface, the direction at which to apply the bed mould. It may be noted that in its application to the top surface the bed mould will project over the upper joint surface as shown in P—X of Fig. 4, while in its application to the lower surface it will not reach to the surface of the joint.

Having marked on the mould, the cylindrical surfaces may readily be formed in the manner an ordinary piece of circular ashlar may be worked. Having cut the faces the points given in 1—12, 1—14 at the convex; and in 6—12′, L—14′ at the concave face, give the points at which to apply the face moulds developed for the surfaces in question. No difficulty will be experienced in the working of the twisted top and under surfaces of the coping, if the straight edge be applied to the radial points as those given in b—b, etc., of the face moulds of Figs. 5—6 Plate 6A. Having worked the coping to its rectangular shape it may be moulded in the manner "circular moulding" is generally worked. Trammel on the cutting lines, gauge sinkings, etc., noticing that it is now the plumb lines which only are the straight ones at the moulded face. "Reverses" will also be found of aid in giving the direction at which to form the curved contour of top surface, for a section as that given in the diagram Fig. 2 of this plate.

Charles H Fox.

THE SPECTACLE BRIDGE.

THE Japanese have always been an ingenious people and have constructed many noteworthy bridges in comparatively ancient times. Wooden cantilever bridges are in existence which were built in the early part of the seventeenth century. The noted Flying Bridge over the river Nishikigawa was built about 1670 and rests on stone piers which were cemented together with lead.

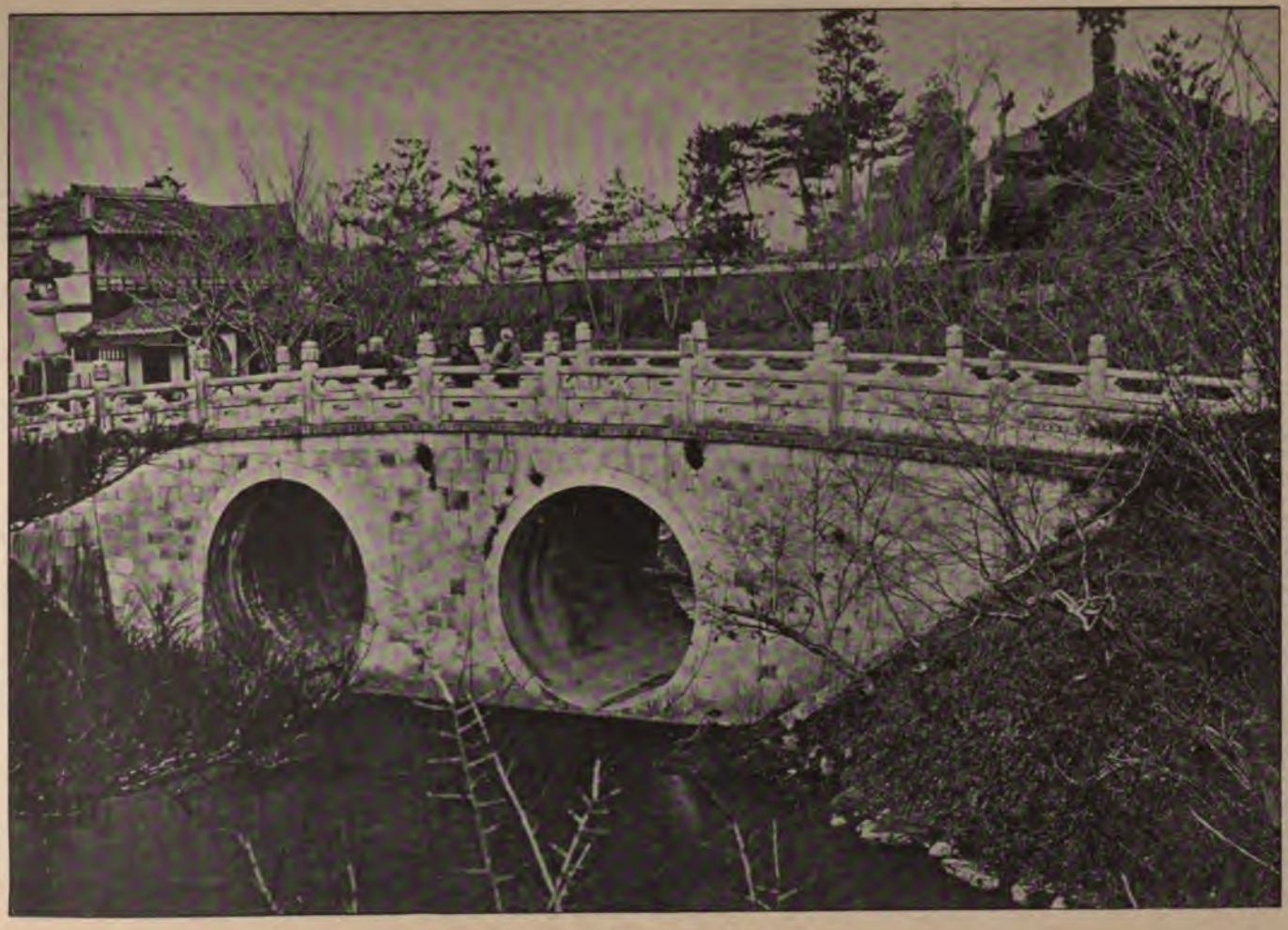
These Japanese structures besides being of remarkable interest as works of engineering, have a special charm in their picturesqueness, which is added to by the beauties of the landscape. The most interesting perhaps of the stone bridges is the Nishi O-tani at Kioto, or the Spectacle Bridge. It would be difficult indeed to imagine what prompted so novel a design as the two circular openings which give it the name. The spandrels are neatly fitted around the ring stones and the masonry is remarkably good. The grades are much better arranged than on many structures. The balustrade is very characteristic of Japan and very appropriate. *"F."*

BRIDGE OF ALCANTARA*

LESS is known about the architecture and engineering of Spain than of any of the other European countries. There are many interesting bridges at various points, but the most famous ones are those at Toledo. The oldest one was constructed by the Emperor Trajan and was a marvel of engineering. The one illustrated was constructed in the year 997. The general style of the structure is Roman—bold circular arches, of which the larger one has a span of ninety-three feet.

The starling of triangular section, supports a counterfort, which afforded opportunity for constructing a retreat. A second retreat is cantilevered out over the right abutment, and while it is a pleasing detail, the patched condition of the wall destroys the effectiveness of this and the small Moorish arch, which is placed in a location which is unaccountable. The tower at the left. and the arched portal at right end of the roadway contribute to make it a striking piece of bridge architecture, notwithstanding the lack of harmony which has resulted from the various additions which have been made. The portal at the left is of Moorish origin and is a very notable example of this feature of bridge design. *"F."*

*Subject of Frontispiece.



THE SPECTACLE BRIDGE, KIOTO, JAPAN.

WAGES IN UNITED STATES AND EUROPE 1870–98.

THE Department of Labor at Washington, under the capable direction of Commissioner Carroll D. Wright, has collected very interesting data relative to the wages paid in skilled trades in this country and Europe, which are published in the September Bulletin of the Department recently issued. From this data we cull such portions as relate to the stone trades:

TABLE I.—MASONS, STONE—AMERICA.

Year.	Baltimore.	Boston.	Chicago.	Cincinnati.	New Orleans.	New York.	Philadelphia.	Pittsburg and Allegheny.	Richmond.	St. Louis.	St. Paul.	San Francisco.	Average.
1870	$3 46¼	.....	2 74⅜	$2 47¼	.....	$2 88½	$2 30¾	$2 56	$2 88½	$1 85½	1 85½	$5 00	$2 80¾
1871	3 79½	.....	4 51¾	2 71	.....	3 16¼	2 55¾	2 72¼	4 06½	2 03¼	2 03¼	5 00	3 26
1872	3 87⅜	.....	4 58¾	2 75	.....	3 20⅜	3 20¾	3 05½	4 12½	2 06¼	2 06¼	5 00	3 39¼
1873	3 77	.....	3 10½	3 10½	.....	3 10½	3 10½	2 93¾	3 99½	1 99¾	1 99¾	5 00	3 21
1874	2 95½	.....	2 24½	2 91¾	.....	2 69¾	3 14¾	2 91¾	3 14¾	2 02	2 02	5 00	2 90½
1875	2 92¾	.....	2 22¾	2 66¾	.....	2 66¾	3 11	2 44½	3 11	2 00	2 00	5 00	2 81½
1876	3 22½	.....	2 66	2 55¾	.....	2 21¾	3 10¼	1 99½	3 10¼	3 54½	1 99½	5 00	2 94
1877	3 45⅛	.....	2 82½	1 94	.....	1 88¾	3 29½	1 88¾	3 29½	3 76¾	2 11¾	5 00	2 94½
1878	3 51¾	.....	2 95¾	2 12	.....	1 97¼	2 19¼	1 85	3 45¼	3 94½	2 85½	4 8-¼	2 97½
1879	3 56¾	.....	3 50	2 00	.....	2 50	1 87½	2 00	3 50	4 00	2 89½	4 83¼	3 06¾
1880	3 77¾	.....	3 50	2 18¾	.....	2 50	1 66¾	2 19½	3 50	4 00	2 89½	4 89¼	3 11¼
1881	3 68¾	.....	3 50	2 98¾	.....	3 00	2 30	3 00	3 50	4 00	3 50	4 95¼	3 44¼
1882	3 61½	.....	3 50	2 98	.....	3 50	2 59	3 08¾	3 50	4 00	3 50	4 93¾	3 52
1883	3 60¾	.....	3 50	3 19½	.....	3 50	2 00	3 30	3 50	4 00	3 50	4 91	3 50-¼
1884	3 56¾	.....	3 50	3 18¼	.....	3 50	3 30	3 30	3 50	4 00	3 50	4 91	3 62½
1885	3 57¼	.....	4 00	3 14	.....	3 25	2 83¼	3 30	3 50	4 00	3 50	4 91¾	3 60¼
1886	3 86¼	.....	4 00	2 87	.....	3 50	2 04¾	3 30	3 50	4 00	3 50	4 94½	3 55¼
1887	3 83¼	.....	4 00	3 24	.....	3 50	2 50	3 26¾	3 00	4 00	3 50	4 89¾	3 57¼
1888	3 95½	.....	4 00	3 24	.....	3 50	2 21½	3 25¾	3 00	4 00	3 50	4 83¼	3 55
1889	3 77¼	.....	4 00	3 24	.....	3 50	2 00	3 32	3 00	4 00	3 50	4 84½	3 51¾
1890	3 98¼	.....	4 00	3 60	.....	4 00	2 58¼	3 63½	3 00	4 00	3 50	4 80	3 71
1891	3 98¼	.....	4 00	3 54¾	.....	4 00	2 85¾	3 60	3 00	4 00	3 50	4 85¾	3 73½
1892	3 94½	.....	4 00	3 60	.....	4 00	3 12½	3 59	3 00	4 00	2 40¾	4 38½	3 60½
1893	3 94½	.....	4 00	3 60	.....	4 00	3 09½	3 78	3 00	4 00	2 36¾	4 40	3 61¾
1894	4 11	.....	4 00	3 20	.....	4 00	2 40	3 01½	3 00	4 00	2 36¾	4 41¾	3 45
1895	4 12½	.....	4 00	3 20	.....	4 00	2 59½	3 38¾	3 00	3 60	2 36¾	4 43¾	3 37
1896	3 11	.....	4 00	3 20	.....	4 00	2 83¾	3 15	3 00	3 60	2 39¼	4 37½	3 36½
1897	3 12½	.....	4 00	2 56	.....	4 00	2 68¾	3 15	3 00	3 60	2 39¼	4 40	3 29¾
1898	3 12½	.....	4 00	2 40	.....	4 00	2 75	3 15	3 00	2 80	2 39¼	4 41	3 20¾

STONE-CUTTERS—AMERICA.

1870	3 29¾	3 37½	2 88½	2 88½	3 71	.....	2 85	3 20½	2 88½	2 06	2 47¾	4 13½	3 07
1871	3 61¾	3 63¾	3 16¼	3 16¼	4 06½	.....	3 09¼	3 46¼	3 16¼	2 36¼	2 71	4 11¾	3 32½
1872	3 66¾	3 68	4 58¼	4 58¼	4 12½	.....	3 45½	3 75¼	3 20¾	2 25¾	2 75	4 07¼	3 64¾
1873	3 55	3 99¾	2 66¼	3 99¼	3 99¼	.....	3 31¾	3 51¾	3 10½	2 21¾	2 66¼	4 07¼	3 37¾
1874	3 59	3 56¼	2 24½	3 59	4 04	.....	3 36½	3 06¾	2 69¼	2 21¾	2 69¼	4 04½	3 19
1875	3 55½	2 75¾	2 00	3 55½	3 55½	.....	3 32¾	2 66¾	2 66¾	2 13¼	2 66¾	4 04¼	2 99¼
1876	2 66	2 44	2 21¾	2 88	3 32½	.....	2 93	2 21¾	2 66	2 55½	2 66	3 77	2 75½
1877	2 82½	2 46¾	2 35½	2 35½	2 35½	.....	2 69½	2 11¾	2 82½	2 52	3 04½	3 79	2 66¾
1878	2 95¾	2 78½	2 46½	2 22	2 46½	.....	2 46½	2 40½	2 95¾	2 59	3 45¼	3 66¾	2 76¾
1879	3 00	2 68	2 50	2 25	2 50	.....	2 07	2 25	3 00	2 67¾	3 50	3 70	2 74
1880	3 00	2 58¼	3 00	2 09	2 50	.....	2 49¼	2 51½	3 00	2 78½	3 50	3 66¼	2 83
1881	3 00	3 14¾	3 00	2 83¼	2 75	.....	2 76¼	3 25	3 00	2 80	3 50	3 67¾	3 06½
1882	3 00	2 79½	3 00	3 08	3 00	.....	3 29¾	3 37½	3 00	3 06¾	3 50	3 65	3 16
1883	3 00	3 01¾	3 00	3 39	2 75	.....	3 24¼	3 53	3 00	3 06¾	3 50	3 61¾	3 19¾
1884	3 00	3 60½	3 00	3 50	2 50	.....	3 27¾	3 55½	3 00	2 81¼	3 50	3 61½	3 21½
1885	3 00	3 08	3 00	3 15	2 50	.....	3 28¾	3 60	3 00	2 81¼	3 50	3 61¾	3 14
1886	3 25	3 02¾	3 50	3 60	2 50	.....	3 03¼	3 60	3 00	2 87½	3 50	3 64¼	3 23
1887	3 25	3 16¼	3 50	3 79	2 50	.....	3 04¼	3 61¾	3 00	3 00	3 50	3 63½	3 27¼
1888	3 60	3 08½	3 50	4 05	2 50	.....	3 38¾	3 61½	3 00	3 12½	3 50	3 67¾	3 36
1889	3 60	3 16	3 50	4 05	2 50	.....	3 33¼	3 81	3 00	3 12½	3 50	3 68¾	3 38¾
1890	3 60	3 32¼	4 00	4 05	2 50	.....	3 27¾	3 70	3 00	3 36¼	3 50	3 67¼	3 45½
1891	3 56¼	3 32½	4 00	4 05	2 50	.....	3 52¾	3 97¼	3 00	3 4 ¾	3 50	3 64¼	3 50½
1892	3 44	2 94¼	4 50	4 05	2 50	.....	3 51¾	3 97¾	3 00	3 51¾	3 37½	3 6 ¾	3 49¾
1893	3 44	2 76	4 00	4 02½	2 50	.....	3 51¼	4 12½	3 00	3 65¾	3 39½	3 60½	3 45½
1894	3 44	2 81	4 00	3 60	2 62½	.....	3 53½	3 60	3 00	3 14½	3 39½	3 62¼	3 34¼
1895	3 44	2 51½	4 00	3 60	3 00	.....	3 53½	3 60	3 00	3 20	3 39½	3 62¾	3 36½
1896	3 44	2 66¼	4 00	3 60	2 50	.....	3 53	3 60	3 00	3 30	3 3 ½	3 67¾	3 33¾
1897	3 44	2 82¾	4 00	3 60	2 75	.....	3 08¼	3 60	3 00	3 05½	3 3½	3 61	3 30½
1898	3 44	2 94¾	4 50	3 00	2 75	.....	3 15	3 60	2 66¾	2 56¾	3 39½	3 51¾	3 23

TABLE II.

MASONS, STONE—EUROPE.				STONE-CUTTERS—EUROPE.		
Year.	London, England.	Paris, France.	Liege, Belgium.	Year.	Paris, France.	Liege, Belgium.
1870	$1 53	$1 01¼	.....	1870	$ .87¼	(a)
1871	1 53	1 01¼	.....	1871	.87¼	$0.58
1872	1 51	1 01¼	.....	1872	.96½	.62
1873	1 59¾	1 06¼	.....	1873	.96½	.67¾
1874	1 59¾	1 06¼	.70¾	1874	.96½	.69¾
1875	1 59¾	1 06¼	.62¾	1875	1.22¾	.75¼
1876	1 59¾	1 06¼	.62¼	1876	1.22¾	.79¾
1877	1 59¾	1 25½	61¼	1877	1.22¾	.78¾
1878	1 59¾	1 25½	.59¼	1878	1.22¾	.77¼
1879	1 59¾	1 25½	.59¼	1879	1.22¾	.72½
1880	1 59¾	1 44¾	.71	1880	1.22¾	.72½
1881	1 59¾	1 44¾	.71¼	1881	1.23¾	72½
1882	1 59¾	1 54½	.73½	1882	1.23¾	.68¼
1883	1 59¾	1 54½	.72¾	1883	1.24	.71¾
1884	1 58¾	1 54½	.71¼	1884	1.24	.68
1885	1 58¾	1 54½	.72¾	1885	1.24	.67½
1886	1 58¾	1 54½	.72¼	1886	1.24¾	.64¼
1887	1 58¾	1 54½	.73½	1887	1.23¾	.69¼
1888	1 58¾	1 54½	.72¾	1888	1.23¾	.73
1889	1 58¾	1 54½	.73¾	1889	1.23¾	.77¼
1890	1 59¾	1 54½	.73½	1890	1.50	.75½
1891	1 59¾	1 54½	.72¾	1891	1.50	.74¾
1892	1 52	1 54½	.73	1892	1.50¾	.71¾
1893	1 60½	1 54½	.73¼	1893	1.50¾	.71
1894	1 60½	1 54½	.73	1894	1.50¾	.73¾
1895	1 60½	1 54½	.73	1895	1.50	.78½
1896	1 68¾	1 54½	.71	1896	1.50	.70¾

In studying Table I. it should be borne in mind that wages for the United States, as originally taken from the pay rolls by the agents of the department, were (except for San Francisco) in currency, and that during the period from 1870 to 1878, inclusive, this money was considerably depreciated. In order that a strictly accurate comparison, therefore, may be made between these earlier years and the years from 1879 forward due allowance has been made for such depreciation, and the figures given for these years are those secured by a reduction of the original currency wages to their equivalent in gold. In converting wages in currency into wages in gold the value of $100 gold in currency for January of each year from 1870 to 1877, and the average value for the entire year 1878, as given in the American Almanac for 1879, have been used, as follows: 1870, $121.3; 1871, $110.7; 1872, $109.1; 1873, $112.7; 1874, $111.4; 1875, $112.5; 1876, $112.8; 1877, $106.2, and 1878, $101.4.

Table II. contains the result of the investigation into wages paid in foreign countries, showing the actual average daily wages paid from 1870 to 1896, inclusive, in London, Paris and Liege, as deduced from the quotations of individual rates from these cities. These wages are, of course, given in gold, and occupations may safely be compared with the same occupations as shown for the United States in Table I.

THE LIMESTONES OF CENTRAL NEW YORK.*

LIMESTONES consist of carbonate of lime, when pure in the proportion CaC (O)3. Frequently, however, they are impure and may then contain silica, clay, oxides of iron, magnesia, and bituminous matter. These materials may enter into their composition sufficiently to give character to the mass, and in such cases the limestone is said to be siliceous, argillaceous, ferruginous, magnesian, or bituminous.

The chemical composition is subject to great variation and there is an almost endless series of gradation between these various kinds. Thus, the magnesian carbonate may be present from traces to the full percentage of a typical dolomite, or the silica may range from the fractional percentage to the extreme limit where the stone becomes a calcareous sandstone.

In color there is a wide variation from the light, almost white, color of the pure carbonate of lime through gray, blue, yellow, red, brown, and black. The color is dependent upon the impurities.

The texture also varies greatly. All limestones exhibit a crystalline structure under the microscope, but to the unaided eye there are crystalline and massive varieties. There are also coarse crystalline, fine crystalline, and sub-crystalline varieties according as the crystals are larger, smaller or recognized by the aid of the magnifying glass only. The terms coarse-grained or fine-grained apply when there is a resemblance to a granular sandstone. The terms saccharoidal, when it is like sugar; oolitic, when it resembles the roe of fish; crinoidal, made up of the stems of crinoids, are terms frequently used when its texture is described. The state of aggregation of the constituent particles may vary greatly, being hard and compact like chert, or loosely held together and crumbling on slight pressure, or dull or earthy, as in chalk.

While none of our limestones are really marbles, this term applying strictly to those crystalline, granular limestones, which are susceptible of a fine polish and adapted for decorative work, nevertheless the Onondaga Limestone because it is a semi-crystalline granular mass, and is susceptibie of high polish, and frequently used for decorative work, is often called a marble. The term limestone, however, is the proper designation of this rock as it is really an unaltered sediment rather than an altered or metamorphic mass.

*A paper read before the Onondaga Academy of Science, June 4, 1897, by Philip F. Schneider.

All fossiliferous limestones are made up of the remains of organisms which have grown in situ, or else have deposited as marine sediments. In the latter case the fossils are more or less comminuted and held in a calcareous matrix. Generally the fossil portions of the mass are crystalline, the gray lime is a good example. The fossil remains are less prominent and scarcely visible in some of the blue limestones. These rocks are compact, homogeneous, and apparently uncrystalline and unfossiliferous. They are usually more or less siliceous or argillaceous, the clay often occuring in seams rudely parallel with the bedding planes. On weathering the difference in composition is often rudely apparent at a glance.

The variation in the strength and durability is as great as in the composition and texture. Some are stronger than many granites in their resistance to crushing force and equally enduring; others consist of loosely cohering grains, and are friable, and rapidly desolved by atmospheric agencies. The more siliceous and compact limestones are generally the stronger and more durable.

Of the limestones in Central New York which have been used for building purposes, the Lower and Upper Helderberg have been quarried extensively both for local use and for exportation, the Niagara and the Tully are only locally used, while the Vermicular and Goniatite are only rarely used even in the regions of their immediate outcrop.

THE NIAGARA LIMESTONE.—The Niagara Limestone has its fullest development in the western part of the state, where it is largely used for building purposes, numerous quarries being opened at various points between Rochester and Niagara Falls.

In Central New York the beds resemble in the main the typical western layers, but they are usually thinner. In our northern towns it has been used to some extent for rough wall work and for foundation purposes. It is also suitable for bridge work, as the stone piers and abutments for the bridge at Bridgeport indicate The stone is granular and has a shining glistening appearance, the layers being usually very dark colored. Fossils are rare, the layers so rich in these organisms in the western part of the state being unknown in Central New York.

THE VERMICULAR LIMESTONE.—The Vermicular Limestone is a peculiar dolomitic variety of a bluish gray color, found in the upper part of the Salina Group. It is perforated with a large number of cavities closely resembling worm-borings. The pores are irregular circular cavities rarely exceeding a quarter of an inch in diameter, though frequently much smaller, which extend in almost every direction throughout its mass, In the rock exposures of this vicinity, these cavities show no filling, excepting a slight calcareous crust which is sometimes present, but some specimens of the same rock obtained from the salt shaft at Livonia hundreds of feet below

the surface show the same cavities filled with salt. A chemical analysis of this rock and salt is being made at present by Dr. Francis E. Engelhardt, city chemist of Syracuse, and will be reported upon later.

LOWER HELDERBERG LIMESTONES.—The Waterline and Tentaculite limestones are included in this group. The common "blue" limestone which is used almost exclusively in this vicinity for foundation purposes and for burning into quicklime is obtained from the Waterlime group. It occurs below, between, and above the layers of the "drab" waterlime. It is a fine-grained, compact homogeneous mass of a dark blue color, and contains some few varieties of fossils. The intervening beds of drab limestone, quarried at present in large quantities for burning into hydraulic cement, occcur in the layers sandwiched between layers of the blue limestone. The drab is entirely without fossil remains.

The Tentaculite limestone is not very well developed in this region although it occurs in beds of varying thickness above the blue and drab waterlime with which it has frequently been confounded.

UPPER HELDERBERG LIMESTONES.—There are three recognized subdivisions of this limestone which stretch across Central New York, the Onondaga Gray, the Corniferous, and the Seneca Blue limestone.

The Onondaga, or Gray Limestone, is the most important economically, and is undoubtedly the finest limestone for building purposes in the state. In a recent bulletin, Dr. F. J. H. Merrill, director of the New York State Museum, says: "It is gray in color, and coarsely crystalline in texture, and makes beautiful ashlar work, either as rock-face or as fine-tooled decorative pieces." The well-known Split Rock and Reservation quarries in Onondaga County have produced an immense quantity of excellent and beautiful stone which has found a market in all parts of the state. Continuing he says: "The aggregate output of the quarries in the Upper Helderburg limestones exceed in value that of any other limestone in the state."

The Corniferous limestone, the second member of the series, is hard and durable, but in many localities is so full of chert that it can only be used for rough kinds of wall work. Occasional layers are comparatively free from chert.

The Seneca limestone is easily dressed and makes a fairly good building stone. Not much is used, however, compared with the quantities of Onondaga Gray, and Blue Waterlime which are annually put upon the market. All three of the Upper Helderberg limestones are extremely fossiliferous.

THE GONIATITE LIMESTONE.—The Goniatite limestone is an impure, dark-colored bituminous mass occuring in the lower part of the Marcellus shale. It becomes brittle after long exposure; and on account of the thinness of the layers and the poor quality of the stone for work of any kind it

has been used only sparingly even in the region where it abounds. It is interesting on account of the abundance of its fossil remains, especially the cephalopods. It is the earliest formation in which the goniatite is known to occur.

THE TULLY LIMESTONE—The Tully limestone is a thin formation lying between the Hamilton and Genesee shales. It is found only in Central New York, having its greatest development in Onondaga County where it is thirty or more feet in thickness. It disappears to the westward in Ontario County. It furnishes a good stone for rough work, but is not used outside of the region of its immediate outcrop. It is quite fossiliferous, two of its specimens being unknown outside of this thin formation.

OTHER LIMESTONES.—A few thin seams of calcareous rock occur in the Hamilton shales, but they are too impure for cassification with our limestones. Calcareous tufa also occurs in large quantities in this region, but has no important economic value.

NORTH CAROLINA KAOLIN.

"NORTH Carolina has perhaps the best generally distributed deposits of high class kaolin of any state in the South, and while they fall short of other sections of the country in quantity, they exceed in quality," remarked E. B. Reed, of Wilmington. "There has been no particular effort made to develop any of this territory, principally for the reason that there are no potteries of consequence in that country. Once this industry is developed in the South, there will be no little attention devoted to the kaolin county of the state, and land that at present is not saleable at all will be on the market at fancy prices. The deposits run like the cannel coal of other states, in bunches irregular and uncertain. A vein of the clay may be found to present every evidence and indication of inexhaustibility, but still crop out with hardly a moment's notice in the working. The only other southern state that is endowed in this particular line is Florida, but there is a vast difference in favor of North Carolina. While the clay is found largely in the mountain country, it is usually so placed as to be easy of access and within easy reach from suitable shipping points. Considerable of the territory has been brought up by northern pottery interests with a view to later development, but the great bulk of the region is entirely unattended."

TERRE HAUTE, IND.

At this writing very little is being done in the building line, nor are there any prospects in the near future. However, in other branches there is considerable activity such as Car Works, R. R. Shops, Founderies, etc., all such shops being fairly busy at present.

During the past week the County Commissioners awarded contracts for road improvements as follows in Nevins Township: The lowest bidder was $37,555. In Linton Township the lowest bidder was $29,000. These two contracts, with other two, which is now partially completed runs the amount up to about $120,000 which is being expended on road improvements throughout this county, also in the city sewer building is being continued. Early last Spring sewer contracts were let for the completion of a belt sewer system. The contract called for the work to be completed in three years, so much expended yearly. The contractors have during the season run their work as far as the amount appropriated would carry them, and now the contractors and City Council have entered into an agreement to continue the work, the contractors to receive 45 cents on the dollar until April, 1899, when the taxes are due. Altogether it looks like returning prosperity, and these different improvements give work to quite a number of men.

KANSAS CITY, KANSAS.

I have delayed writing for some time expecting to hear of something interesting to the trade, but nothing of any importance turned up. About ten stone-cutters are working on the Electric Fountain, and will have it finished about Christmas if the weather permits; besides this there is little cutting done, and no more prospects for this year.

Carpenters and masons have plenty to do, but stone-cutters must be content getting a few sills or steps occasionally, and to make matters worse prices are so depressed and competition is so sharp that a stone business in this city is not a paying business any more. It seems in this instance that competition is rather death to business than the life of it.

CLEVELAND, OHIO.

There is nothing new to report. No work is being done except that which cannot be left over. Prospects for the coming spring and summer are really good, especially so if the municipal building can only be started. There appears to be some opposition to one of the commissioners recently appointed by the Mayor, the opposition coming from the City Council which has the power of authorizing the issuing of bonds for the erection of the building, and at a recent meeting of the council the bond ordinance was defeated, so we can now expect to see a little political see-sawing from now on to the spring elections, between the administration and the council.

The school council of this city received and adopted the report of the building committee which was for stone as against terra-cotta on the two new High School buildings. The school architect is now busy at work on the drawings, and bids are to be asked for as soon as possible, as the districts in which the schools are to be built are sorely in need of them.

The stone cutters of Cleveland are well pleased at the knock-out blow that terra-cotta received on these two buildings. GEORGE.

PHOTOGRAPHING ON MARBLE.

To the Editor of STONE:

Sir: — In October STONE instructions were given for making photographs on marble, and prompted by curiosity as much as anything else I tried the experiment, but with very unsatisfactory results, in fact, no results at all. I coated the marble with the solution, and exposed in the sun-light for six hours, and there was no more sign of a face on the marble than there was on the moon. I could not see any change in the color of the coating after it had been exposed in the sun for so long a time.

Now, will you kindly inform me if it requires any special skill to produce the desired effects, and will you please give me further light on the subject (if I haven't got too much light on it already)? Of course, anyone thoroughly versed in photography understands that some manipulations in the dark are necessary, and I presume this process of photography is similar. Any information on the subject will be greatly appreciated. Yours truly,

Logansport, Ind. E. WORSTELL.

[If others of our readers have experimented with the formula referred to, we would be pleased to hear from them—Editor of STONE.]

DAYTON, OHIO.

Building activity is on the increase in Dayton and promises to develope some substantial results. Architect Acton has prepared plans for a five-story business and apartment house at the corner of Bridge and Monument Avenue. It is stated that a syndicate has been formed and that as soon as financial details can be arranged the work of the building will be started. This structure of course will be modern in every particular. Mr. Acton also has plans for two double dwelling houses: M. G. Cain, a $3,500 house in Dayton View; the M. E. Church in Riverdale, and several other buildings.

Mr. Frank H. Aull will erect a $15,000 residence in Dayton View, while Charles W. Shank will construct one in the newly developed Pierce addition in Riverdale, the cost of which

will approach $12,000. Peters & Burns have charge of these residences.

Sutter & Putnam have plans for two large dwellings, one to cost $7,000 and the other $10,000.

Mr. A. B. Bridgway is making progress with his contemplated improvement of the old Wheatley property on West Fifth Street and will proceed at once to erect a double dwelling, rather two dwellings, to cost respectively $6,000 and $5,000, Architect Brook has charge of the plans.

Glover Brothers have plans for two dwellings the reported aggregate cost of which will be $15,000.

Architect Robert E. Dexter is preparing plans for a residence of his own to be built on the boulevard at an expenditure of $10,000. Mr. Dexter will construct the dwelling according to his own original ideas.

The Algonquin, at the corner of Third and Ludlow Street, is a splendid building and would prove a credit to the metropolis. The work of construction has advanced to such an extent that the building is now almost ready for the roof. Both the builders, Pierce & Williams, and the Architects, Williams & Andrews, deserve praise for their efforts in connection with the enterprise.

Work on tearing down buildings for the new depot and passenger yard was started in earnest Wednesday, November 16. Contractor Mr. J. J. White and his partner, Mr. Milliken, engaged 120 workmen who are wrecking buildings, clearing away the debris and putting the place in shape as the work progresses. According to the plans for the Union Railway Depot, by which name is to be known, this magnificent structure, it will be 45 feet high and 215x53 feet in size. A tile roof is to be placed thereon. One grand accomodation to be afforded the public will be a clock tower 125 feet high with a dial eight feet in diameter, this chronometer will be illuminated at night and can be seen quite a distance. Another feature is to be added to the building. Originally it was intended to have several umbrella sheds for the accomodation of people who arrive and leave the depot in hacks and private conveyances. On account of the structure being so completely hemmed in by other buildings this grand arched entrance will be so constructed as to conceal the umbrella shed. They will average about 930 feet in length.

The latest information from Cincinnati states that it will naturally be some time before bids are opened for the work, but when they are, work will be pushed as soon as practicable. The architects of this magnificent structure are Elzner & Anderson, of Cincinnati.

L. H. Webber got a $6,000 contract to cut stone for Mr. Winter's residence. The structure will be Bedford Stone; also E. H. Talbott was awarded $1,200 for Mr. Winter's porch. The material will be free stone.

Mr. Adam Shontz purchased a lot for $34,000 just one square north of Union Depot, to build a first class hotel nine stories high.

D'ONOFRIO.

BINGHAMTON, NEW YORK.

The Ingalls-McClintock Stone Co. have recently purchased the steam stone plant located in Binghamton, N. Y., and built by Frank Carlucci about a year ago, also the stock on hand. The plant consists of planers, gang saws, and steam derricks, and is full and complete in every respect. Consideration $12,000.

They will close their yard in same city and move all the material and derricks to the new plant. They have work enough on hand to keep them busy for nearly a year.

FORT WORTH, TEXAS.

The stone trade continues dull, a couple of small jobs going on. The Hoxie office building which was let on the 23rd of last month, will not have much stone in it. About five car loads of Ohio stone. The city fire hall here has started, but the stone-cutters after working three day are all loafing for stone. A small quarry has the contract to furnish stone, and from the way it is coming in they will average about one car a week, it being built of Dublin, Tex., limestone. It is a fine stone and a good working stone. It is a good opening for a practical quarryman with money enough to operate it right. Very few country jobs going on in this section of the state. A hotel at Jacksboro, all cut stone, also a few store buildings at Mineral Wells, are about all the country jobs I know of at this writing. Trusting that the stone trade may revive in 1899.

TEXAS.

MILWAUKEE, WISCONSIN.

Janesville is going to have a new jail; cost not to exceed $25,000.

Bruno Fink is putting up here a handsome dwelling of brick and stone; cost $10,000.

The Kieckhefer Co. is going to erect a series of buildings five stories high to cost $150,000.

PEORIA, ILLINOIS.

The City Council passed what is known as the Levee Ordinance, giving rights and priveleges to the following railway companies to do business and make extensions in the City of Peoria: The C. R. I. & P. the R. I. & P. and the Peoria & Pekin Traction Co. One of the provisions is that they erect a Union Depot costing not less than $50,000, to be completed inside of eighteen months.

Prospect Heights people, adjoining this city, have been incorporated. They having secured the location of some new factories. A boom is expected there. Several dwellings are being erected at present.

The Methodist Episcopal people intend building a Deaconess Home and Hospital. Committee is appointed to have suitable plans drawn and to let the contract at once. Basement to be built now, and the balance to be finished in spring. The site is secured, which cost $12,000.

SCALLY.

BUSINESS TOPICS.

Contributed by the National Association of Credit Men.

DATING AHEAD.

The subject under consideration is the practice of selling and shipping a bill of goods, say January 1, and dating the invoice March 1, terms say sixty days from date. How and why did this practice originate? The habit of dating ahead came upon business men so insidiously that it was hard to tell e actly when they found themselves laboring under the impression that dating ahead is essential to the commercial life of the customer, and that the customer demanded it. In time, however, observation showed that the customer was not being benefited by the custom. Practical experience proved that it was injuring him. If an investigation were to be instituted it would demonstrate that the desire for dating ahead did not originate with the customer, but instead is something that he was persuaded into adopting.

The salesman was about to miss getting an order, notwithstanding the fact that he had priced the goods lower than usual. The customer urged that he did not want the goods, and saw no use in having them upon his shelves, exposed to dust and risk of loss by fire and theft. The salesman said: "That is all right. You will need them. I'll tell you what I'll do. I'll ship them now, date the invoice sixty days hence, and give you sixty days from that date. You'll gain the reputation of carrying a better stock than the merchant across the street, and besides you can sell your goods on longer time than your competitor, because you buy them on better terms. We have an immense stock, and are crowded for room, while your store looks sort of empty."

The salesman's statement and offer were something new to the retail merchant. When he thought the proposition over it became irresistable. It appealed to the weakest spot in a business man's make-up. In fact, it aroused in him the propensity the operation of which kept Diogenes from finding what he sought. The salesman presented what appeared to the customer to be an opportunity to get the advantage of his neighbor. Accordingly, the bill was bought, the goods were delivered, the invoice was dated ahead and all was well—apparently.

Is it surprising that harm should grow out of evil? Is it not surprising that any of us should expect good to come from that which we know is bad? If at night we raise our hearts in worship to the Being whom we say and believe is almighty and all-wise, why in the morning do we try to prosper by doing what He has discouraged and forbidden? If consistency were the only jewel beauty would go unadorned.

Merchant No. 2, across the street, buys his goods from the competitor of the salesman whose little speech to Merchant No. 1 has been recorded above. The salesman of this competitor of the comes along after awhile and meets Merchant No. 2, who has heard that Merchant No. 1 got four months on a sixty-day bill. Salesman No. 2 is told by Merchant No. 2 that he must have just as good terms and so it is arranged. From little incidents of this kind it soon gets abroad that merchants in general will not buy unless invoices are dated ahead.

Every business man bows to the commercial idol, Competition. and the latter like Jove,

> "Shakes his ambrosial curls and gives the nod:
> The stamp of fate and sanction of a god,
> High Heaven, with trembling the dread signal takes,
> And all Olympus to its center shakes."

We are told by philologists that civilization increased our wants, and that it was necessary to create words to name these wants as fasts as they were discovered, and that this process continued has resulted in what we call language. Many business men believe there is, and all of us act as if there were, an irresistible and unerring potentiality continually enacting new laws, and that it is incumbent upon us to find means to obey these laws, just as we have invented words to name our wants. It cost our forefathers very little to label their discoveries, for they were comparatively few, but our devotion to a dietywhom we can neither analyze nor locate has sent the representatives of ruin into many neighborhoods. If we would renounce our commercial idolatry, and let our actions verify the faith we possess, fraternity would supply remedies as rapidly as industrial and commercial progress developed new defects. posterity would say that this process was continued until it led to the millennium.—J. T. Jenkins.

An Odd Monument.

Some odd conceits have been given form in the making of monuments, but probably the only lighthouse monument in the world has just been erected in an English cemetery. It is a full sized lighthouse, not a minature, and it stands on a base of white Italian marble 25 feet in circumference. On this base is carved a representation of waves, just as if the shaft stood out at sea. Around the base is strewn white sea sand, and the idea is further carried out by having a real signal light burning in the tower. This unique monument has been erected to the memory of the late Dr. T. W. Wilson by his daughter and is located in the cemetery at Ulverston, Lancashire. It stands in a prominent position only 20 yards from the main road and attracts much attention.

There are 13 steps leading to the door of the lighthouse, the door to which and the 12 windows being represented in every detail. On a shield above the doorway is carved the letter "W," the initial letter of the deceased's name, the whole being surmounted by a carved white marble dome, supported on four pillars, and between these is a lantern, with radiating lights. Above are four arms supporting a white marble globe.

From the ground to the apex the height is some 23 feet. The gas main has been laid to it from a distance of about 400 yards. The light is 40 candle power and will be kept burning all the year round. The light is so powerful that mica will have to give place to glass.

Over two years were required to build the monument, and 75 tons of marble were used. The total cost of the lighthouse was over $10,000, while the gas will cost about $100 per year.

The Vermont Granite Industry.*

It is but a few years since Vermont had any reputation as a granite producing state, although the existence of extensive granite ledges has been well known ever since the state was settled. In the first report on the Geology of Vermont, which was published in 1845, granite is only incidentally mentioned and not a single quarry is particularly noticed, though there were then a few of no great importance. Probably the largest quarries were then, as now, at Barre, for the state house was built in 1837 from Barre granite, and this was probably very much the largest contract taken by a granite quarry in Vermont until perhaps ten years ago, when, after slowly increasing for many years, the granite business, chiefly at Barre but not wholly, suddenly increased to unexpected proportions.

In 1880 Vermont produced, according to the Census Report, 187,140 cubic feet of granite, which was valued at $56,675. In 1889 the production was 1,073,586 cubic feet, valued at $895,516, and in 1897, according to statistics collected by Mr. G. W. Perry, the granite produced by eighty-seven companies was valued at $1,512,543. In 1880 Vermont ranked thirteenth among granite-producing states; in 1890 it had advanced to

*Excerpts from the last Biennial Report of State Geologist Perkins.

the ninth place, in 1896 to the third, only Massachusetts and Maine producing more, and in that year the latter state did not produce nearly as much as Vermont did last year, and Massachusetts but about 6 per cent. more.

Granite beds are more widely scattered over the state than of either marble or slate. Marble especially is limited to a few comparatively restricted areas. Nearly all of the slate, too, is obtained from the quarries of Fairhaven, Poultney and Pawlet, though the Northfield deposits are considerable, and there are smaller patches in other places. The great beds of granite are at Barre and Woodbury, and these I think are parts of the same vast deposit and no such deposit is to be found elsewhere in the state, if anywhere in the country. Hence these beds will always be the most important. Smaller deposits, however, exist, and most of them have been worked at one time or another. These are found at Beebe Plain, Derby, West Concord, Greensboro, Chelsea, Groton, Ryegate, Williamstown, Northfield, Bethel, Sodom, Victory, Kirby, Morgan, Norton Mills, Dummerston, and perhaps elsewhere, and a syenite at Windsor. I do not mean that granite is now quarried in all these towns, for that is not the case, but it exists in all, and has been at one time or other quarried in all. So far as I can ascertain, there are about seventy firms in the state concerned with either quarrying or manufacturing granite, many do both.

All of the quarries are open, and most, or many, surface quarries. An exposed ledge is attacked and the stone removed. Unlike marble and slate, the granite is not unsound near the surface, though better at a considerable depth below it. Hence there is little or no waste surface material to be removed at greater or less expense. This, as well as the nature of the quarries, make quarrying much cheaper in the granite region than it is in either the marble or slate belts.

The bright, clear color and enduring quality of the Vermont granite are bringing it into favor as never before In several very rigid and thorough comparative tests which have been made recently, Vermont granite has proved superior to any other tested. Perhaps the increase of the granite industry in Vermont is best shown by the facts in regard to the growth of Barre, for there is no reason to suppose that this, for a Vermont town, phenomenal progress, is due to anything else than the development of the granite quarries and the money which this has brought to the town. In 1880 the population of Barre was 2,060, and the property valuation was about $700,000. In 1890 the population had increased to 6,790 and the property valuation was $3,500,000. The population is now estimated at not less than 10,000, and the value of property is considerably larger than in 1890, and the past year has been one of unusual prosperity.

The present value of the annual output in these quarries is thought to be not less than $1,000,000, taken as it leaves the quarry, unworked. Just how many quarries there are at Graniteville and the neighborhood, four miles east of Barre, I cannot ascertain, but there must be between fifty and sixty. About 100 derricks are in use, and 2,000 men, mostly Scotchmen, with a few Italians, are employed in the quarries and finishing shops, or "stone sheds," as they are locally called.

Granite has long been quarried in this region. According to an article in the illustrated edition of the *Enterprise*, one Robert Parker, a revolutionary soldier, first opened a quarry, but not until 1875, when Barre was connected by a branch line with the Central Vermont Railroad, was any extensive work done. So far as I am aware, the first building of importance to be constructed of Barre granite was the state house, built in 1837. The stone for this was delivered in Montpelier for twenty cents a cubic foot, while to-day the same sells at the quarry for from seventy-five cents to $1.00 a foot. From a few tons annually, the amount produced has grown, as we have seen, to large proportions. A single firm shipped in 1896, 10,000 tons, and 1,000 tons have been sent over the road from the quarries to Barre in a single day and 100,000 tons in a year. It is

stated that if all the buildings and yards used in and Barre for cutting and polishing granite were combined they would cover fifty acres. The actual territory in which the quarries are located is not large. Mr. W. C. Olds writes: "The quarries are all within a radius of less than a mile, and certainly not more than five per cent. of the area within this radius is quarry land."

About twenty miles north of the Barre granite beds are those of Woodbury. The beds here form a small mountain, and are, therefore, enormous in quality. Most of the works where the stone is cut and polished are at Hardwick, six miles west, or between Hardwick and Woodbury. On this account the stone is often called Hardwick granite. The quarries here were opened only ten years ago, and therefore the industry is not yet greatly developed. There are at present 220 men employed in the six quarries and probably a much larger number in the "stone sheds." About $300,000 worth of granite will be produced the present year.

At Ryegate a company is working a small quarry and are about to open a new one in Tapham, just beyond the Groton line. Other quarries and works are reported as not running.

There is an important quarry in the southern part of the state at Dummerston. The stone produced by this quarry is of two kinds, a light and a dark, both of good quality.

What is called "Ascutney granite" has been quarried at Windsor. This is really not a granite, but a syenite, which is much that is called granite in trade. The mica of granite is replaced by hornblende. The stone is very hard, darker colored than any of our granites, and I doubt not durable.

The Marble Quarries of East Tennessee.

Mr. J. E. Willard, of Knoxville, Tenn., recently made the following interesting statement.

Geologically considered, the Tennessee marbles can be referred to the Trenon and Nashville series, which are the verlying beds of the Lower Silurian formations. All these formations strike northeast and southwest, and vary from horizontal to dips of high angles. Of the colored marbles, there are endless varieties, from the most delicate pink to the rich brown and chocolate, the gray and dark variegated. This great diversity extends to the texture as well as the color, and the widest possible field is afforded to architects and artists in stone to exercise their taste in the selection and combination of colors. It is only of late that this diversity in these marbles has been known to the trade. The lighter colors, such as the gray and the different shades of pink, seem to meet the popular fancy. As shown by chemical and crushing tests, these marbles are practically impervious to moisture and discoloring agencies, and have all the requirements of a first-class building material—a material that will last for generations. At the present time there are fourteen quarries in operation in Knox and Blount counties, with an average output of 30,000 cubic feet per month. This product is of the different varieties and colors, and is shipped all over the United States, from Maine to California, in the rough block, in sawed slabs, and in the finished state, for the interior decoration of buildings. There are four mills located in Knoxville, which finish and ship marble to the trade. There are over $3,000,000 invested in Tennessee marble. The marble industries of the State are still in their infancy, and are susceptible of development on a scale of great magnitude.

Anchor for Tombstones.

Specification forming part of Letters Patent No. 610,529, issued September 13, 1898, to Winfield C. Gilbert, of Union Bridge, Maryland.

The object of the invention is to provide means whereby tombstones at the head and foot of a grave may be connected together by an anchor buried under the surface of the earth in such manner that their distance apart will be properly regulated and preserved, and they will be held against leaning, falling, or being twisted out of alinement.

With this object in view the invention consists in a tombstone-anchor compris-

ing two plates of metal provided with means for connecting them together in any desired longitudinal adjustment, provided at their outer ends with upright flanges to embrace the outer sides of the head and foot stones, and angular brackets adapted to be adjustably secured upon the upper faces of the metal plates, whereby their upright flanges may be forced into contact with the inner sides of the head and foot stones, screws being provided to pass through the upright flanges of the metal plates and brackets into the head and foot stones to rigidly secure them in position.

Fig. 1.

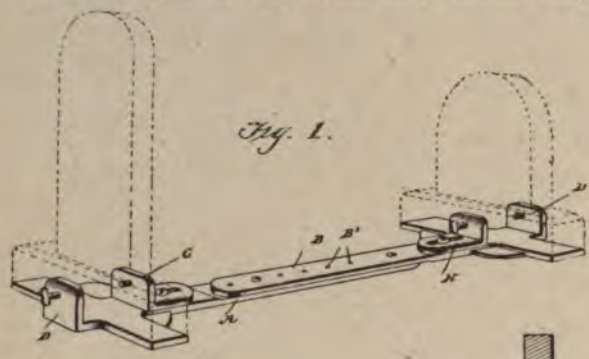


Fig. 2.

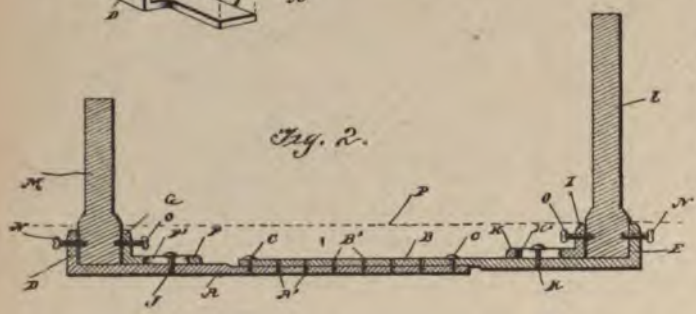


Fig. 3.

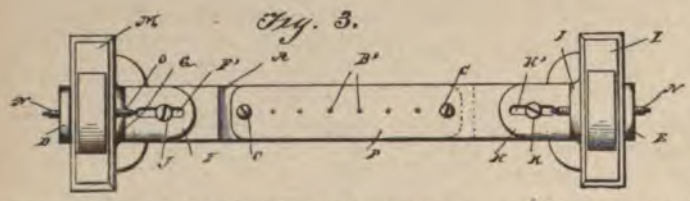


Figure 1 is a perspective view illustrating a tombstone-anchor constructed in accordance with the invention, the head and foot stones being illustrated in position in dotted lines. Fig. 2 is a central vertical section through the anchor and tombstones, the earth-level being indicated by a dotted line. Fig. 3 is a top plan view of the anchor and tombstones connected together.

Like letters of reference mark the same parts wherever they occur in the different figures of the drawings.

Referring to the drawings by letters, A and B indicate two plates or bars of metal adapted to overlap each other at their inner ends, the overlaping ends being provided with registering perforations A′ and B′ to receive screws C to secure them rigidly together in any desired adjustment. At their outer ends the plates A and B are provided with upward turned flanges D.

F and H indicate brackets longitudinally slotted, as at F′ and H′, and provided with upturned flanges G and I at their outer ends. Screws J and K, passing through the slots F′ and H′, serve to permit of the adjustment longitudinallyof the brackets F and H and to secure the brackets in position to clamp the base of the head and foot stones L and M.

Screws N are passed through the end flanges D and E of the metal plates A and B into the outside of the base of the head and foot stones, while screws O pass through the upright flanges G and I of the brackets F and H into the inside of the base of the head and foot stones.

The construction will be readily understood from the foregoing description, and its operation may be described as follows: The grave having been filled nearly full, the plates A and B are laid on the top of the filling-earth and adjusted to the proper length by means of

the registering perforations A′ and B′, and the screws C in a well-known manner. The brackets F and H are now adjusted sufficiently far inward to permit of the placing of the headstone and footst. e on the top of the plates A and B in ntact with the inner faces of the upright flanges D and E. The brackets F an H are now adjusted outward until their ngular flanges G and I rest against the inner faces of the bases of the head and footstones and secured in such adjusted position by means of the screws J and K. The screws N and O are now turned into the holes prepared to receive them in the base of the tombstones, thus securely fastening the stones to the anchor. The filling of the tomb is now completed, the earth rising to about the level of the dotted line P in Fig. 2 leaving nothing exposed above the surface of the earth except the tombstones, which will be rigidly held against displacement.

In Memory of the Heroic Humble.

Mr. G. R. Watts, the famous British artist, has introduced into London a new idea in the monument line which might well be adopted in some of our cities. He is now erecting in what is known as Postman's Park at Aldersgate, a cloister or pavilion of artistic design and imperishable materials, in which will be placed from time to time, tablets commemorating deeds of heroism of people in the humbler walks of life. Postman's Park is a little breathing spot in the crowded section of the city, much frequented by working folks, so that the examples will have an influence upon the moral courage of the lower classes. The London county council and the park board have made appropriations of money and the remainder of the cost, which is $60,000, will be met by private contributors. Mr. Watts is now searching the newspaper files to learn of brave deeds recorded in recent years. A typical case is that of Alice Ayers, a nursey maid, who rescued three children from a burning house at the sacrifice of her own life.

At the last meeting of the New York branch of the Granite Cutters' National Union a resolution was passed providing that hereafter no member of the union shall work upon a job in New York City with aliens. This action was taken to prevent Italian stone-cutters joining outside branches of the Granite Cutters' National Union and getting a transfer card to the New York branch. The resolution is expected to have far-reaching effects.

Shading Marble.

A newly discovered process for treating marble or other similar stones in order to give them any colored shade, veins or spots, consist in leaving these stones in one or more baths composed of a solution of alcohol and one or more colors of aniline or other coloring materials. The coloring materials are fixed by leaving the colored stones in a bath of oil or any other fat substance, or by applying upon the stones layers of the same stuff. The absorption of the organic coloring materials and of the fat substances by the stone may be accelerated by heating or boiling the bath which contains the stuff to be treated. —New Haven Morning News.

SELECTED MISCELLANY.

WANT ter be a boy ag'in, that's what's ailin' me;
Want ter do's I used to do, be's I used to be.
Ain't no chicken as ter years,—no, but what of that?
Looks won't tell how fur she'll jump when yer see a cat.
Hair's a-thinnin' on my head, teeth are gettin' skurce,
But my heart an' soul, I guess, ain't a mite the worse;
They're as young's they ever was, so there ain't no sin
In my wishin' I could jest be a boy ag'in.

When I woke this mornin', land, wa'n't the airth a sight!
Like a painted picter, all blue an' silver white,
Snow a-sparkin' everywhere, flashin' low an' high,
Like the stars had tumbled down from the evenin' sky,
Every tree and bush an' twig on the field or hill
Heaped with shinin' di'mon' dust fresh from Natur's mill.
H'istin' up the sash to let all the glory in,
"Gosh!" I sez, "the world's re-born,—I'm a boy a'g'in."

Through the pastur' brush, I see little rabbit run,
Twinklin' heels a-tossing' up spangles to the sun,
From the barnyard, high an' shrill, come a rooster's crow,
Sayin' "Wake up, lazy folks; time ter shovel snow."
From the neighbor's chimbly tops smoke was climbin' straight,
Like a ransomed sperit bound for the Pearly Gate,
As I tied my tippet on 'round my grizzled chin,
I sez, "Youth's come back ter me,—I'm a boy ag'in."

An' as fur as feelin's go, boy I was, I guess,
But this mortal flesh an' blood ages more or less,
An' an hour of shov'lin' paths showed me I was old,
An', to emphasize the fact, rheumatiz took hold.
So, I'll say, 's I said before, seems to me unkind
That a feller can't be young when he's young in mind;
Seems a pity that a chap who's a boy within,
Can't be havin' fun an' jest *be* a boy ag'in.

—Joe Lincoln in L. A. W. Bullentin.

Stone and Alabaster Vases.

The Egyptians used different kinds of stone for making bowls, jugs and other vases destined to hold the liquids and other substances offered to the gods, or otherwise employed for religious or private purposes. The principal materials used for this purpose were granite, basalts, serpentine and alabaster, or arragonite, a kind of stalamite of great beauty of a creamy-white color, and more extensively employed than and other material, especially for vases of the toilet. The kind in use at the earliest period of the fifth and sixth dynasties was plain and of one uniform layer, but about the twenty-fifth dynasty a zoned arragonite of yellow color and many layers came into use. The principal shapes are a hemispherical vase with wide open mouth for holding wine, basins, cy-

lindrical vases with wide rims for holding unguents or oils, an elongated vase with pointed foot, also for holding unguents or perfumes; a vase with cylindrical body, large flat lips and mouth, often employed for holding cosmetics; and vases in shape of the wine-jugs, the Greek olpe or the oinochoe, the two-handled amphora and drop-shaped albatros, and other shapes. On many of these alabaster vases the name of the monarch in whose r ign they were made, of the person in whose tomb they were deposited, and even the amount of the capacity, or their dedication for sepulchral use is incised in hieroglyphs. The alabaster vases appear to have been highly prized. They had covers of the same material, and were used only for domestic purposes by the upper classes. So much were they esteemed that they were exported from Egypt, and the names of Persian monarchs have been found in hieroglyphs and cuneiform characters upon them, while vases apparently in Egyptian material, if not of Egyptian fabric, have been discovered in the early tombs of Asia Minor, Greece and the isles of the Archipelago.—Stonemason.

Recent Discoveries at Pompeii.

The excavations at Pompeii, says a Naples correspondent of the London Times, have been continued during the past year, and have resulted chiefly in the discovery of small houses containing objects of secondary interest and importance. In the neighborhood of the Gate of Vesuvius a portion of the city wall belonging to the earliest period of Pompeian building was laid bare, and is interesting, as it is apparently more ancient than such other portions of the wall as have been discovered. It appears to be of Oscan construction, being built of large blocks of rough stone neatly joined without mortar, and resembles somewhat the facade of "The House of the Surgeon," though the stones are larger and not so smoothly faced. This section of the excavations being exhausted, the ground already appropriated being finished, the director determined to excavate the small corner near the "Sea Gate," which was the only unexcavated spot in that part of the city. Experts had long been anxious to see what lay buried there, for there was a portion of a very large and handsome red marble pillar, which had long been above ground, and had given rise to sundry conjectures. On removing the soil the site was found to be occupied by the foundations of a temple which was in course of construction at the time of the destruction of the city in 79 A. D. This is particularly interesting because it was supposed that all the sacred edifices of the city had been discovered long ago, no important deity being without a representative temple; but unfortunately there is nothing in the rudiments of the temple before us to indicate to whom it was to be dedicated on its completion. It is evident that, though very small, it was intended to rival in its decoration any temple which existed in the city; and though it had scarcely risen above the ground level, the marble architraves, carved with the usual egg-and-tooth moulding, are lying around it ready to be put up, and the Corinthian capitals, some finished and others only partly executed, are displayed in the enclosure, as well as the base of a pillar upon which the mason was at work at the time of the catastrophe which overwhelmed the city. The tool-marks on this base are clearly perceptible, and look as if the workmen had only just left his task. As to the handsome red marble pillar to which we have alluded, it is reasonable to conjecture that it was the base for the statue of the god, as it is about 4 feet long, and the only piece of colored marble found on the site. The partly executed capitals are extremely interesting, as showing the methods of the Roman artist who was engaged upon them, while those that are complete are very good specimens indeed considering that they belong to an age of decline.

If Pompeii itself has not been productive of sensation this year, a small excavation on private ground only a few yards outside the walls has more than made up for this by revealing one of the finest and most interesting mosaics of antiquity. Surrounded by a most exquisite garland of flowers, with a theatrical mask thrown in here and there to break the pattern, is a picture representing a group of seven philosophers, one of whom is seated with a papyrus in his hand, and the others are grouped round listening to him. In the background are some ruined pillars, and in the right-hand upper corner is a representation of the Areopagus of Athens, with its rocks and buildings. The mosaic is polychrome and in diminutive cubes of very fine workmanship, equal in merit to those by Dioscorides of Samos in the Naples Museum, which are believed to be the only signed mosaics of antiquity. It is about three feet square, and was no doubt, in-

tended for the center of the pavement of a room. It had probably never been used and was a new mosaic, because it was not found on the ground, but leaning against a wall, showing either that it had been moved from some other place or that it was about to be put down for the first time. Its perfect condition leads one to prefer the latter conjecture. The government has purchased it from Signor D'Acquino, and it will shortly be exhibited to the public in the mosaic department of the Naples Museum.

It is generally admitted that the earliest mosaics in Italy date from about 80 B. C., and there can be no doubt that in many cases they were reproductions, or, at all events, traditions of famous pictures. In the case before us, the sketch of the Areopagus, concerning the identity of which there can be no doubt in the mind of any one who knows the spot even in its present state, displays the Greek origin of the work, and the scene depicted must either be some celebrated discussion on "Mars Hill," or, what is more unlikely, a casual group of one of the Attic schools of thought such as might be seen there any day. At any rate, a sketch of the Areopagus which is recognisable at the end of the nineteeth century is no mean treasure, and we are encouraged to hope that one or other of the archæological schools of Athens may be able to throw some light on the subject of this interesting mosaic.

It is not thought likely that the D'Acquino excavations will produce other objects of great importance, as the house so far has shown no signs of being anything more than a suburban villa. After the rich find of silver which was made some three years ago in a house about a mile from Pompeii, and presented by Baron Rothschild to the Louvre, it is unsafe to speak with too much confidence, but the above is the opinion of the expert who is in charge of the excavation.

Cork Roads.

A material in which cork figures largely is said to be excellent for pavements. According to the Carriage Monthly, "the ideal road of the future will be of cork. The bricks are com posed mainly of bitumen and cork, which, mixed with certain other materials, and subjected to pressure, forms a durable, practically noiseless, non-absorbent and perfectly sanitary pavement. The material being of an elastic nature and non-slippery, gives a secure foothold to horses in all sorts of weather. The cork bricks are also applicable to stables and stable yards."

Have Animals a Future Life?

The remarks recently made in the pulpit by the Rev. Forbes Phillips ("Athol Forbes"), vicar of Gorleston, Yarmouth, to the effect that he believed animals had a future existence, and that he would rather meet in heaven some animals than some people he had me. on earth, continue to bring in to him a large number of letters on the subjeet. Apparently the vicar is a firm believer in the equality of the "lower animals" with mankind as regards a life after death. Questioned on the point by a London Daily Mail representative, who was desirous of obtaining a fuller expression of the reverend gentleman's opinion on a subject which has created no little interest, he replied:

"Why not? The conceit of man says 'No.' I venture to think the reason of man says 'Yes.' But in the majority of people conceit very often takes charge and answers before reason gets a chance. I shall never forget the look of alarm and astonishment on the faces of some members of the congregation when I happened once to express n the pulpit my belief in their future life. One indignant parishioner wrote to me to say that 'he refused to share his hope of immortality with his dog and cat.' I pointed out to him that he shared the present life with them, and as far as I knew he had shown no sign of shuffling off this mortal coil. What one may call Paley's physical argument concerning the resurrection or survival of identity, if it hold good of the race, must also hold good of what is sometimes called the lower orde of creation, though I can quite imagine a well-bred, well-behaved animal offeri g a dignified protest against this phrase. Science tells us that the structure which we call the body is composed of atoms in perpetual flux, constantly disintegrating, constantly passing away. The body of childhood is not the body of early youth. Once in every dozen years (some scientists say less), the whole atomical structure of the body is changed. The bodies we have to-day, so far as regards the material elements, have already formed the component parts of other carcasses, and they will in turn dissolve and enter into fresh combinations. But the identity of man remain

the same in spite of all. We change the materia, but the ego, the true self of man, still remains. Death is the final dissolution of partnership between spirit and body. But the change in partnership on the one part is being constantly made. This argument is sound; it applies equally to man and beast. We must either accept it or throw it overboard. If we accept it, e must accept it on behalf of our dumb friends.

"Take another view of life as merely a force. No force can be lost in this universe. What is the relation of animal consciousness to the mighty life which pulses through things temporal and eternal? Why should it cease, or come under the exceptional law of annihilation? Aga n, we believe in a just God. Surely there is some compensation for our dumb friends for wha they suffer here. Surely there is some reward for their loyalty, their faithfulness, their courage, and the higher faculties they manifest! Has all this to count for nothing in the eyes of Him, without whose notice not a sparrow falleth to the ground? But, objects some one, the Bible does not mention their future existence. The Bible omits a number of things which we believe and act upon. The truth is, the men who wrote the Bible no more doubted the future existence of their beasts than they did their own. Job speaks of the spirit of the man, and the spirit of the beast.

"It is rather curious that the scriptural word used to denote the future life, 'paradise,' throws considerable light on the subject. The word '*paradeisos*' is found in the Sanskrit, an older language, under the form 'paradesha.' It is also to be found in Armenian, Arabic, Syriac, Chaldee, Persian, and, of course, Greek. Sometimes it is translated in the Bible as park and other times as forest. The word has the same identical meaning in all languages, and implies a pleasure garden, well watered, and inhabited by all kinds of harmless beasts and birds. The idea in the Eastern mind is obvious. Our animal companions will have a share—it may be a subordinate share—but a part they have in that future beyond the threshold of the shadows. Western science agrees here with Eastern speculation. The moral conviction of a future, which protests against the extinction of life with the dissoluti n of the atomical embodiment, to the logical mind, must also include and protest against the extinction of the life of other animals as well as that of man. After all I do not see why so many people should object to such a belief which every age and nation have borne witness to. If there are inhabitants in Mars, would the unbelievers in the future of animals deny immortality to the Martians? The Catholic interpretation of redemption surely is not limited to men, women and children of this bit of star dust in the universe! Such a frame of mind can only be compared to that of the famous cock that thought the sun rose every morning for the special purpose of hearing him crow.

The Energy of Explosives.

The relatives energy of explosives has been assumed about as follows:

Gunpowder	= 1
Nitro Glycerine	= 4
Dynamite	= 5
Gun Cotton	= 5
Explosive Gelatine	= 6

All such comparisons must be accepted as rough approximations, since the same explosive under apparently similar conditions gives discordant results. This probably arises from the fact that the same explosive compound varies somewhat in its exact constitution according to the purity of the materials used in its formation; and, again, exact measures of the forces developed by explosives are impossible. It has been calculated that one pound of nitro glycerine develops about 1,100 foot tons of potential energy. Compared with one pound of coal, which has a potential energy of about 5,000 foot tons, there is a marked contrast. On this point it has been suggested that the explosive has to expend a large amount of work in converting its condensed oxygen into gas before it can combine with the combustible elements o the explosive.

The *rationale* of the detonation of explosions is not well understood. That it is not solely due to heat is evidenced by the fact that it is possible to detonate wet gun cotton; and from the phenomena of sympathetic explosions, which will be referred to later, it would seem that detonation may possibly arise from the vibratory action of the detonating agent upon the molecules of the explosion. The elements of the explosive molecule are retained in stability by delicately balanced forces; and if these forces are thrown into changed vibrations by an external force, such as the sharp initial explosion of a fulminate, the molecules of the

explosive are broken up, and detonation follows. It is known from experience and observation that the energy of a high explosive depends somewhat upon the character of the initial detonation by which the main explosion is secured. One ounce of gunpowder, even when strongly confined, exploded in contact with gun cotton, only inflames it, while ten grains of confined fulminate of mercury produces a full explosion of the gun cotton. Forty-five grains of fulminate exploded unconfined only inflames gun c tton. Quite large quantities of dynamite detonated in contact with gun cotton only disperse it, while a small amount of dry gun cotton detonated upon a mass of wet gun cotton produces a perfect explosion.

That the energy of explosion depends upon the nature and force of the initial explosion is probably true of all explosives, including gunpowder. A too low initial explosion will simply produce a rapid burning, instead of a detonation of the explosive. Through a defective exploder I have seen one charge of dynamite out of a large number simultaneously exploded under water simply burn, with the continued violent boiling of the water over the charge for several minutes. It is evident from experience that an initial detonation of at least a definite intensity is required to obtain from the explosive its maximum effect. With an insufficient initial explosion combustion ensues, while with a sufficiently large initial explosion complete detonation results. As gun cotton is exceedingly inflammable, this material, with the exception of small quantities, is generally kept wet. The wet gun cotton can be efficiently exploded by the initial explosion of a small quantity of dry gun cotton, in which the fulminating cap is exploded. As a protection against the premature explosion of nitro glycerine, it is requently kept, until required for use, in a congealed or partly frozen condition, which occurs at about 45° Fahr. The detonation of high explosives is generally obtained through the aid of electricity, by which a fulminating cap or fuse, containing about twenty-four grains of mercuric fulminate, is initially fired in the explosive. By this means a certainty of fire is secured, and when, as in blasting, a number of holes are to be fired at the same time, an increased efficiency is secured by the simultaneous discharge of all the blasts at the same instant. In the removal of Flood Rock, East River, in 1885, one hundred and fifty tons of explosives were fir ed by this method at the same instant.—From a paper read by Louis V. Schermerhorn, before the Engineers' Club, Philadelphia.

Cyclopean Wall.

The general character of the Cyclopean style is immense blocks without cement, and though the walls are now irregular, from smaller stones which filled up the interstices having disappeared, yet they were once so compact as to seem an entire mass. The stones at the foundation were smaller than those above. Schneider, editor of "Vitruvius," contends that the style called by that author "insertum" does not mean small stones thrown into cement, but large stones, among which smaller were inserted—a style called "antiquum" also by "Vitruvius" because it was the most ancient manner of building. Hamilton divides the style into four periods, viz., the first or oldest is that used at Tiryns and Mycenæ, consisting of blocks of various sizes, of which the interstices are or were filled up with small stones. The second, as at Iulis and Delphi, is marked by polygonal stones, which nevertheless fit into each other with great nicety. In this style there are no courses. The third, as in the Phocian cities, and in some of Bœotia and Argolis, is distinguished by the work being made in courses, and the stones, though of unequal size, being of the same height. The fourth and youngest style presents horizontal courses of masonry, not always of the same height, but formed of stones which are all rectangular. This style was chiefly confined to Attica. Tiryns is the first known specimen of military architecture or improvement upon earthworks, for Pliny says that the Cyclops are affirmed to have been the inventors of the fortifications of towns and also of towers in these identical instances, of Tiryns and Mycenæ. Sir William Gell adds that Tiryns is the best specimen of the military architecture of the her ic ages. Homer calls it the well-walled Tirynthus.

The Slate Export Trade.

The most notable point in the American slate trade at the present time is the rapid growth in export business. A few years ago this was of too small value to be considered, but at present it is the most prominent feature of the trade. An opportunity for the introduction of our slates abroad was given by the strike of the Welsh quarrymen and the long suspension of work which followed. Advantage was taken of the opening, and a foothold has been secured, which can very probably be retained. It is claimed that the finest quality of Welsh slate is better than the American, though our quarrymen are not by any means willing to admit this. This quality, however, has only a very limited sale, owing to its high price, and the ordinary grades of roofing slate are very similar to the American slates which are sold at a lower price. So far Great Britain has been our chief customer for slate, though small quantities have been sent to Germany, France and Denmark. The growth of the trade is shown by the fact that the exports to the United Kingdom in the fiscal year ending June 30, 1893, amounted to only $1,400, but in 1897 they had jumped to $695,980. Of the total value of $1,370,075 in slate shipped from the United States to all countries in the fiscal year 1898, fully $900,000 went to the United Kingdom. During the next fiscal year it is likely much more slate will be sent to that country, as the port of New York has already shipped there during the four months from July 1 to October 31 nearly $245,000 worth of slate, which compares with $557,099 in the whole fiscal year ending June 30, 1897. There have also been shipments from Philadelphia and Baltimore as well as from other minor ports. New York remains the chief exporting port.

The main point now is to retain the trade which the difficulties of the English quarrymen have put in our hands. It has been suggested that it would be well to establish a central selling agency in London, with a warehouse where different varieties of American roofing slate could be kept on exhibition, with sufficient stock to fill orders needed at short notice. To do this would of course require the co-operation of a number of producers, among whom the necessary expense could be divided.

Most of the Pennsylvania and Vermont quarrymen are united in appreciating the value of the export trade, and they should at the same time realize the advantages of more active work towards increasing the use of roofing slate at home. In the Eastern States especially there is room for a good deal of work in this direction.—Engineering and Mining Journal.

Rockmart, Ga., Slate Quarries.

We are informed that negotiations are in progress for an increased development of the slate quarry interests at Rockmart, Ga., and that steps are being taken to increase the capital there invested with a view to increasing the slate plant and greatly enlarging the capacity of the slate quarries. Slate roofing and other slate products will be manufact-

ured, including marbleized slate mantels, blackboards, etc.

It is proposed to establish a large number of agencies of these quarries in all the cities south of the Ohio River, also at Chicago, St. Louis, Cincinnati and in the large cities west of Chicago and the Southwest. Agents will also be appointed in Europe, and the trade in the South adjacent to to the quarries will be energetically pushed.

It is confidentialy expected that these quarries will give employment to several hundred men, and as a natural consequence it is reasonably assured that the town of Rockmart will be greatly benefited thereby.

The Rockmart slate has a great advantage in location for supplying the Southern, Southwestern and Western markets.

This inexhaustible and compact body of slate is located in northwest Georgia, in Polk County, near the town of Rockmart. The quarries lie along the line of the Southern Railway, and are well situated for transportation in any direction, south, north, east and west, or to the seaboard for shipment to Europe. It is said that it is so located that it can control the largest area of purchasing territory of any of the great slate deposits of this country. The splendid climate will enable the quarries to be worked all the year around, while the cheap labor of the South and other advantages will, without doubt, insure success.—Southern Field.

The Monson Maine Slate Co. which has been five months in arrears on their men's wages, have paid them in full to October 1. They have long orders ahead and are running their mill day and night. W. A. Evans has taken a contract of the Monson Consolidated Slate Co. to cut from the company's land, and deliver at their quarries 1,000 cords of wood.

Our Home Market for Slate.

In pushing the sale of slate for both domestic use and export, roofing slate has been the product almost exclusively referred to. The export trade of the past year or two has been in roofing slate, with the exception of a small quantity of school slates, the value of which has been very moderate in comparison. There is a large field to be worked in the domestic market in the supply of slate for construction of various kinds. For use in household construction—as for wash-tubs, sinks and similiar purposes; in staircases, floors of passages in public and office buildings; for tanks and water cisterns; for acid tanks and similar purposes in chemical works and factories, slate possesses many excellent qualities. Its resistance to chemical action of all sorts, its non-absorption of moisture and its smooth, hard surface combine to fit it especially for the classes of work mentioned. No material is more easily kept clean and free from dirt of all kinds; while in fireproof construction its advantages are apparent. Marbleized slate for decorative purposes is rather out of fashion at present; but for other household purposes its use is increasing. Our slate quarrymen ought to push these uses of their product more energetically. They would certainly lose nothing by work in the directions indicated, and might gain a good deal in the extension of the market for good slate.—Engineering and Mining Journal.

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TECHNICAL MISCELLANY.

The Escurial Spain.

Spain possesses one of the largest buildings in the world. It is at once a palace, a museum, a library, a picture gallery, a monastery, a church and a burial place. This wonderful edifice is called the Escurial (a hill or a heap of stones taken from a quarry), and is located about twenty-five miles northwest or Madrid.

It was commenced in 1653 by order of Philip II. of Spain, and was intended partly as a royal burying place for the kings of Spain, and partly as a commemoration of Philip's victory over the French at St. Quentin in 1557. It is built entirely of granite, and measures 744 feet in length by 580 feet in breadth. At each corner is a tower 200 feet in height. The building is supposed to represent an enormous gridiron lying upside down, and this shape is believed to have reference to St. Lawrence, who was martyred on a gridiron. Twenty-one years were spent in building it, and it cost $12,000,000—an enormous sum at that time even for a palace. It has been twice partly destroyed by lightning, and was sacked by the French soldiers in 1808. It is said to contain 14,000 doors and 11,000 windows.

Arches on Columns.

The practice by means of which the arch and column became amalgated as integral parts of the same ordinance, viz., that of supporting arches upon columns, making them spring either directly from their capitals or from an entablature-shaped block over them, is almost uniformly condemned as barbarous and absurd. That it was introduced during the decline of the art and that it was an innovation subversive of former principles is not to be denied. Yet if it must be reprobated it ought to be so for its own demerits, not as an innovation, for all invention is such. It appears a very poor argument against it to say that columns were originally designed to support horizontal architrives; we do not see how that circumstance, of necessity, renders every other application inadmissible. At that rate we must censure as vicious a great deal of both Roman and modern architecture, where attached columns are employed merely as an ornaments, yet as frequently as not in such manner as to produce a character of littleness and poverty, they being so small in proportion to the rest as to appear insignificant, and at such intervals from each other that all the beauty and harmony of a columnar ordinance is lost. Where columns are employed to support it certainly cannot be alleged that they are idle unmeaning expletives, nor that they are mutilated by being apparently partly embedded in the wall behind them. "A pier," it has been remarked, "is but a differently shaped and more massive column," which being granted, what impropriety can there be in employing the latter as a substitute for the other, provided it be done with judgment and discretion, and where upon the whole it will prove an advantageous mode of treatment? It certainly is a barbarous mode to turn small arches upon columns which are not more than between two and three diameters apart, of which we have examples in the basilica of S. Paolo, and Santa Agnese fuor delle Mura at Rome. The intercolumns are such that they might easily have been closed horizontally; indeed

the openings between the columns have scarcely the appearance of being arches, but the whole looks as if the wall resting upon the columns was scooped out into diminutive arches over the intercolumns. In those instances, too, the arches themselves are quite plain, without archivolt or mouldings of any kind, and consequently all keeping is destroyed; the architectural embellishment terminates with the capitals of the columns, and so far the effect is similar to what would be produced by placing a plain horizontal mass upon a range of columns instead of a moulded entablature. Although one of an opposite kind, it is equally a fault to make the arches spring not immediately from the capitals of the columns, but from square fragments of entablature over them (as, for example, in the interior of St. Martin's, London), not only because such fragments are unmeaning in themselves and suggest the idea of the columns having been found too short for their intended purpose, but because they remind us quite unnecessarily of the original application of the column to the horizontal entablature. If entablature be admissible at all it is when the columns are coupled, for then some kind of architrave at least become requisite in order to connect the two capitals, as it were, together.—The Architect, London.

The Effect of Frost on Building Material.

Natural cements should never be used in freezing weather. The cement once frozen has lost all of its binding property. Thawed out it crumbles like mere sand. Portland cement, however, behaves very much better, and it is contended that some brands are especially fit for use in frosty weather. No proper explanation can as yet be offered as to this particular difference in quality.

Common mortar, however, should be considered as being subject to no detrimental change in its properties through the action of frost. On the contrary, it is improved. This is especially evident in all cases in which the mortar steadily continues—for a time of three to four months—to remain in a frozen state, so as to allow all surplus moisture to vaporize. Plastering thus "frozen dry" turns out to be the toughest and in every respect best kind of such work. Where roofing tile are jointed with mortar, the best work is ever obtained in steadily frosty weather, lasting long enough to allow the mortar to set. But the difficulty in our climate is that such steady frost-weather can never be depended upon. We are bound to resort to artifiicial heat in processes of plastering, to say nothing of the advantage in saving time. A peculiar property of frozen mortar is, that when a sudden thaw sets in, shortly after freezing, this mortar will become quite liquid. It will drop from the plastering lath, will also freely ooze out from the joints in a stone wall.

Stone walls should never be built in frosty weather, or at a time when frost may set in shortly thereafter. If the stones are laid in common cement mortar, they would be no better off than if laid in dry sand, if as well, If laid in lime mortar the case is even worse, because the mortar in heavy joints, where none or very little of its moisture is absorbed by the stone, becomes so liquid when thawing that it will freely ooze out from the joints and thus leave the masonry more or less unstable. In case stone walls are imperatively called for they should, therefore, not be built with lime—or common cement mortar. A proper kind of Portland cement is required. Considering this as to expense and as to the possibility that the kind of cement chosen is not the proper one, it would appear to be like a positive rule for every practitioner to avoid in frosty weather the use of common stone on any kind of walls. Foundations may be of dimension stone bedded in sand merely; basement walls of brick laid in lime mortar. In case exterior faces of these walls are to be shielded against dampness, it would be utterly useless to apply the usual cement mortar coating, the full efficiency of which is doubtful in any case.

When, soon after the great Chicago fire of 1871, the rebuilding of the city began, basement walls were in a number of cases built with rubble stone. Frost soon thereafter setting in and remaining

almost constant till March in the year following, their green mortar was in solid condition enough to sustain the superstructure in the meantime thereon erected. But so soon as the March weather set in they were speedily converted into a loose mass of rubule, held in a precarious position by a loose mass of mortar, which began to ooze out and endanger the stability of the structure. A remedy was found in the speedy call of the "house doctor" and his jackscrews. Yet so ignorant were both architect and builder as to the threatening cause, that the "doctor" was discharged after the rectification of a south wall, to be called again within a week thereafter, in order to also uphold the north wall, which had followed the example of the south wall.

An "accident" took place on another street, where a block of three stores, four stories, high, fell all on a sudden into a heap of ruins. Its basement walls, some six feet high from the ground, had been built of stone. "Jack Frost" had solidified them for the time being. The walls were completed and roof put on. When "Jack" took his leave the structure was doomed. Lucky it was that the crash took place early in the morning prior to starting work.

The lesson then so repeatedly given had, however, not sufficed to afford the necessary amount of instruction. A prominent member of the profession undertook, two years thereafter, to build in winter a stone cellar wall of a store, with no favorable result. Had the tottering wall been an isolated one instead of one leaning against the wall of an adjoining store, it would probably have come to the ground.

Contrary to general opinion on the part of the public, it must be stated as a fact that masonry is *improved in its quality* by the action of frost, provided it has received the amount and degree of care required. It is in disrepute because the conditions on which success depends have so seldom been altogether well observed, even if they were at all understood. When mortar freezes, when the ultimate parts of its humidity expand into solid crystals, the rubbing motion of particle against particle then taking place is, without question, a very severe one, enough so to exact an improved condition of them, especially in regard to the silica which thereby seems to become in a measure "unlocked." It is converted, partly so, from its original inert state into one of more or less acute affinity, by which the silicatization of the lime is started, and increased in rapidity of its action. My own conviction in regard to the fact that masonry properly executed in frosty weather is comparatively the best, is positive. It is shared by good and attentive masons as well as a number of architects. All that is required in the case is, that the subject be more fully investigated and results taken *ad notam*. A time-honored prejudice will then be fully dispelled.

The necessity of "keeping the weather out" from inhabited buildings is self-evident, and protective measures, especially as to exposed parts, such as fire walls and chimney tops, owing to the introduction of Portland cement and terra cotta lap-coping, have at last become a rule. Facts have gradually had the effect of demonstrating a necessity, from which no part of a building is excepted. A most special care is owing to monumental structures which, as the case is, are designated to endure for ages. Frost is their principal enemy. Water enters into the minutest open joint and ever expands it by freezing. It is to be kept in mind that this expansion taking place is ever and ever repeated with irresistible force. It is exceedingly difficult, if at all possible, to construct monumental work, self-evidently to be durable, with small pieces of material, the joints between them offering so many chances for gradual destruction.

A cemetery vault was, some eight years ago, constructed at Graceland Cemetery, Chicago, with arches composed of small blocks of granite. The structure was altogether neat and attractive, affording evidence of a good deal of happy thought on the part of the architect. But the grim existence of "Jack Frost" had not entered upon his mind. The result was that improved arches were made in the spring following.

In the earlier days of our common-

wealth, attention to the destructive agency of frost seems to have been rarely paid. Many a cemetery vault then built on the side of a hill, the arch covered with soil and sod, has gone out of existence owing to the destructive agency of frost. Some of them have been rebuilt in place of being abandoned. All of them, I trust, could be made permanent by not only covering the arch with a coating of Portland cement concrete, but also protecting this coating with sheet lead of fair thickness, the sheets soldered.

The fewer the joints, the larger the constructive units, the more certain the durability of the structure. All joints should be carefully prepared for filling with lead, to be firmly caulked. Such caulking requires that the blocks be massive in order that they may resist all lateral motion thereby induced. This necessity should be considered a factor in the style of all monumental work.

The superficial inspection of the New York-Brooklyn suspension bridge reveals a want of care as to results of the action of frost, and even government work is, here and there, allowed to be thus injured. I have noticed heavy granite copings on quite new retaining walls somewhat moved off their beds. The retaining walls to the approaches of our river tunnels have been rebuilt twice and are again leaning, owing to an ever-repeated freezing of the ground which leans against their back. On our principal residence streets are shown a large number of fence copings to be in a "demoralized" condition, brought on by the action of frost. The time for proper care and attention in regard to the relentless action of frost seems, after all, to be as yet in suspense.—Frederick Baumann, F. A. I. A., in Inland Architect.

Electric Power in Mining.

Progress in the introduction of electric mining machinery has been, to an extent, hampered by considerations which did not enter largely into street railways and lighting work, but which have played an important role in the electric mining field. In the case of electric street railways and electric lighting stations, new industries were to be created, which for capital might appeal to the whole world. There was no question of extinguishing the value of an existing investment.

In arguing electricity into a mine, however, the mine operator has not only had to consider the question of a future benefit, but also what must appear to him the more serious one of a present loss, and it is a known fact that old apparatus assumes in the mind of the owner a factitious value as soon as the question arises of discarding it, and purchasing new apparatus in its place. Furthermore, the change involved not only the supersession of mechanical and animal power in the mine itself; it involved the installation of a complete steam and electrical generating plant at the same time. Electricity, therefore, has been compelled to show that its adaptation to mine work would not only mean future economy, but, also, that its economy would be sufficiently large to compensate for the extinction of the value of the apparatus at present in use. That it has been shown capable of this is, perhaps, best demonstrated by the very large number of mines now using electrical apparatus, and the still larger number in which the use of electricity is proposed and almost decided.

It will hardly be disputed at this date that electricity is the ideal power for use in the operation of mines, and that the advantages it offers, and the benefits which accrue from its use, cannot be equalled or even approached by any other known power, whether animal, steam or air. A power that needs heavy piping; that demands expensive protec tion in very cold weather and constant expensive maintenance; that cannot be transmitted satisfactorily over long distances; and that operates machinery demanding constant attention, compares poorly with a power that requires two or three slender wires only for its transmission; that gives off no heat, nor smoke, nor moisture; that is unaffected by change in temperature, however severe; that can now be transmitted over long distances, which, five years ago, would

have been deemed fabulous; that can be employed indifferently above or below the surface, by day or night, or continuously the twenty-four hours through, and that drives machinery which demands the minimum of attention. And when to these advantageous features are added decided economies in the operation of the workings, cheapening, and at the same time, increasing the output, while demanding no extensive expenditure for maintenance, the attractiveness of electricity as motive power is irresistible.—John McGhie in Cassier's Magazine for November.

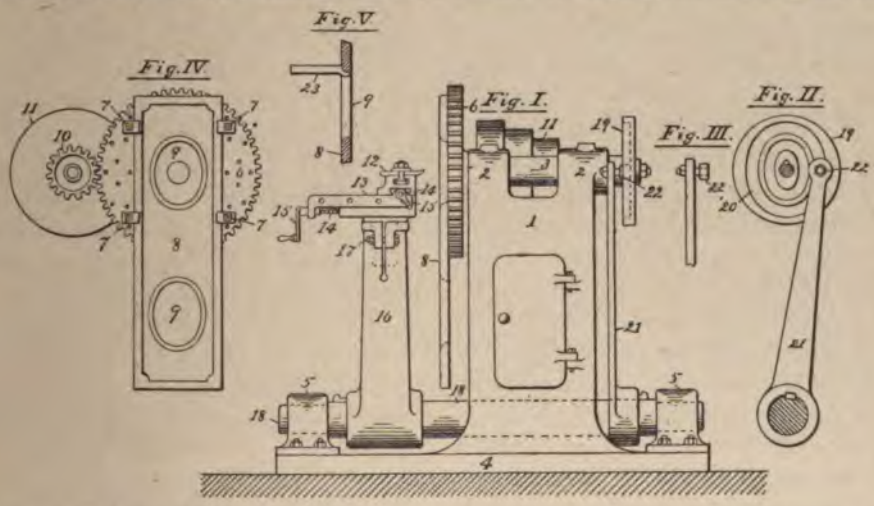
Machine for Cutting Marble or Stone.

Specification forming part of Letters Patent No. 610,810, issued Sept. 13, 1898, to M. J. Hawley and John B. Clot, of San Francisco, Cal.

This invention relates to a machine for cutting apertures of a circular, oval, or other form bounded by curves through marble or other stone, and for moulding the edges of such apertures. The improvements consist of a strong spindle arranged in the manner of a lathe, provided with a face-plate on which are clamped the slabs of marble or other stone to be cut, and a cutting-tool mounted on an oscillating shaft operated by a cam on the main spindle, so that the cutting-tool will have a transverse movement across the axis of the slab's rotation and coincident with its revolution, whereby holes of a circular or other curved symmetrical form can be cut through the slab and the edges be trimmed or molded.

The objects of the invention are to obtain accuracy of size and contour for such apertures, to uniformly shape or mould the edges of the same, and to perform this work in a rapid manner without the exercise of special skill.

Figure I is a side elevation of a machine for cutting holes in marble or other slabs of stone, constructed according to this invention. Fig. II is a view in elevation of the face of a cam-wheel for cutting oval holes, and the lever that operates the oscillating bar on which the cutting-tools are supported. Fig. III is a detail of Fig. 1, showing an edge view of the guide-roller that moves in the cam-plate. Fig. IV. is a front view of a slab in which oval apertures have been cut, the revolving face-plate on which the slab is mounted, and the main driving gearing. Fig. V is a detail showing the manner of shaping and molding the edges of holes or apertures after cutting through a slab.



In cutting holes or apertures through slabs of stone, especially marble tops for toilet-basins and the like, it is desirable that such apertures have a true contour and be symmetrical in form; also when two or more holes or apertures are cut in one slab that their position, shape, and dimensions be uniform. These ends are attained by this machine in a simple and efficient manner, as explained in the specifications of the letters patent, and which are too lengthy to present herewith.

TIMELY TOPICS

[The date of publication of STONE is the 15th day of the month, instead of the 1st, as heretofore.]

Chicago's "Marble" Quarry. The reported taking of cores of marble of very high quality from beneath Chicago—"real, rich and beautiful marble, fit for any palace or suited for any kind of ornamental work."—as the chronicler describes it, must have caused a cold chill to traverse the spines of the Vermont, Tennessee, Georgia and other marble supplying companies of the great Chicago market. But, only a chill, perhaps, like what the smashing of a carload of marble slabs would cause to the consignee who was anxiously awaiting its arrival. This marble is said to lie very deep in the "bowels" of the earth, and yet lies under the very "heart" of Chicago. Note the juxtaposition of the "lies!" Beneath the floor of a quarry pit 185 feet in depth, at a distance of 125 feet, the core drill "struck something harder and tougher" than the familiar Niagara limestone which abounds hereabouts, and is not insignificant itself in hardness and toughness. So we must conclude what the drill "struck" was something extraordinary. The chronicler asserts that it is a marble "tough as granite and capable of a high polish," and that "the farther down the drill was sent the harder the marble was found to be."

Now, we all know how invaluable is that material for "any kind of ornamental work" that is extremely hard to work and is "away up in G" in price. Hence the vision of a marbleized Chicago, when its foundations shall have been upturned, and its ghastly pyramids of ugly brick and uglier terra cotta shall have disappeared!

Again, says the reporter, "at another point another specimen was brought up by a drill, quite similar to the one already described, but which, some experts who have seen it, think it would make an excellent lithographing stone." See how nicely that part of the tale rounds out a perfect *tout ensemble:* First strata, paving stone; second strata, building stone; third strata, limestone; fourth strata, marble; fifth strata, something harder than marble, let us presume a granite, which is a fine thing for columns and pilasters; sixth strata, slate to provide a roof for it all, and underlying all "an excellent lithographing stone," in which are the footprints of the prehistoric hustlers who made Chicago busy then as now, and upon which will be written the future chronicles of its surpassing greatness. The drill-hole that discloses all these marvels is in close proximity to the "gold factory" that flourished awhile and collapsed so suddenly!

Bribery and Advertising. Our brother Granite must not measure STONE by the "slide" rule of advertising patronage, wherein its editorial opinion is concerned. We do not write for, or refrain from writing at advertisers when discussing trade mat-

ters. Our New England contemporary ought to know by this time that is not the policy of this journal. STONE solicits advertising patronage without distinction as to "race, color or previous condition" of hard-upness, when it believes those it solicits are legitimate concerns and will pay the bill for genuine service. In one respect STONE is essentially different to any other periodical in its class—it is strictly a subscriber's journal—and could live without an inch of advertising patronage if it had to. The advertiser in STONE gets more out of it than we get from him, because of the fact stated. So, when Granite, in reprinting our "Note of Warning" editorial anent the pneumatic tool litigation, commiserates us on the probable loss of advertising patronage in consequence, we admonish it not to trouble itself on our account. It doesn't follow that in selling advertising space candid comment should be stifled against an advertiser who has been caught at bribery and intimidation. An advertiser who expects to buy silence with his order for advertising is *persona non grata* to every honest publication.

A Marble Fight. It seems to be difficult for anybody but marble experts to distinguish between Colorado marble and marble from other states that finds its way into Colorado. There has been constant complaint against the contractors for the marble work on the new capitol, that they are violating the contract which calls for Colorado marble exclusively to be used. It is intimated that Colorado marble cannot be supplied in required quantity because of inadequate quarrying and transportation facilities, and that work on the building would have to stop if outside marble was not brought in. The queer part of this state of affairs is, the attempt to conceal the identity of the marble so substituted and to leave the impression that it is the Colorado material. A good many funny charges and challenges have been the result so far, and it wouldn't be much of a surprise if open hostilities broke out between contractors and citizens parties to the dispute.

The Policy of Organization. Returning once more to a consideration of the litigation threatened by a pneumatic tool company against users of tools not of its patent or manufacture, let us repeat that we think it is all a big bluff, but at the same time a prettily put-up one. All the more reason why the trade should become organized to confront it. A bluff is as good as a blast sometimes. If one timid concern is wheedled into paying for immunity from threatened litigation, there will be found others eager to seek cover in the same way. That's what brings demoralization to the trade, and enhances the advantages of the prosecutors. The only defense against the aggressive enemy, and against the cowardice of selfish operators, is general organization, embracing district, state, and national bodies.

We are advised that there now exists a protective association composed of manufacturers of pneumatic tools, other than the "McCoy," and many users of competing tools. That's not the sort of organization that is best, in our opinion, for the users of pneumatic tools. It is well enough to accept the aid of every outside firm and individual in defeating the patentees of the "McCoy" tool in their effort to collect tribute for use of alleged infringing tools, but it is not absolutely certain that makers, or pat-

entees, of other tools than the one referred to, may not in the future proceed in like manner to levy tribute on them. It is not a wise plan to form alliances of this sort with apparently friendly parties. Let it first be known they are unmistakable friends. Uncle Sam appreciated the help of the Cubans and the Filipinos, in his struggle with the Spaniards, but the allies didn't occupy the first firing lines or the first seats in the council chambers. The stone-working trade is glad to receive the aid and comfort of pneumatic tool manufacturers in this fight, but, thank you, they want the first and lasting fruits of the victory that is sure to follow their united resistance to the "patent Spaniards."

The best aid the manufacturers of pneumatic tools for stone-cutting can contribute to buyers of their implement, is to wrap it in a bond protecting the purchaser in its use.

Justice and Injustice. Shakespeare has furnished the lines that express the pathetic case of poor old John Hooper, the Chicago monument dealer, who was sent to the penitentiary a few days ago for the alleged crime of stealing eighteen tombstones:

> "If I shall be condemn'd,
> Upon surmises, all proofs sleeping else,
> But what your jealousies await, I tell you,
> 'Tis rigor, and not law."

Here's an old man nearing seventy-five years of age. He had been engaged for more than a quarter of a century in the monument business in one location; was respected and honored by the people of his neighborhood in all this time. When adversity reached him, and his shop and stock were taken on a levy and bought in by his accusers, the old man, reasoning in his feeble way, perhaps, (for an old man in trouble is not clear-minded,) and confident that he was entitled to a portion of the property he had stored at another place, held possession of the eighteen pieces. For this he was arrested, tried and convicted, and sent to the penitentiary. Oh, what pity, what sorrow in all this! Not pity for a criminal, not sorrow that the majesty of the law has been upheld, but pity and sorrow that this old man, whose whole life until its near ending has been environed in rectitude and integrity, should be "condemn'd upon surmises, all proofs sleeping else, but what jealousies await." For there is naught but surmise that an act like his was determined crime; all evidence of the man's past honorable career simply counted for nothing against the vindictiveness of the prosecution.

Turn from this case to that of the young scamp, who embezzled $5,000 or more from the Western Stone Co., and wasted it in riotous living. He was the protegè of the tender-hearted president of the stone company, whose devotion and confidence he had flagrantly, shrewdly and willfully betrayed. This pampered profligate was not even so much as arraigned for his crime—a crime a thousand times more fit for example of the law's inflexible rigor than that committed by old John Hooper, because its impression rests upon the youth and manhood of the country, while that of Hooper impresses all as the sequence of senility.

Who can find justice in the law when administered so oppositely as in the cases cited? It has been unspeakably cruel to a good old man gone wrong by one act in his extreme old age, and it has been complaisant to a humiliating degree to a cultured scoundrel who had probably pilfered from the cash box every day for years. The weak old man, who for a lifetime was honored and respected

by all, has gone to an early grave in the prison yard for his first, last and only offense against society. "'Tis rigor, and not law (justice)." The strong young fellow who robbed his best friend, disgraced his parentage and gave to society another example of profligacy, goes unwhipt of justice. That's laxity and not law.

The Padrone System. There's something lacking in the enforcement of law in this country while the padrone system of supplying labor is permitted to exist. This system appears to be more firmly established in the marble and granite centers of the East than anywhere else. The Italian granite cutters in New York City are, under the system, first required to be members of the National Union, because, as the padrones recognize, the highest standard of wages are insured by such membership. Then the padrones extort from the cutters one-fourth the amount of the wages paid them. There's a law of the union prohibitory of this, but it is difficult to ferret out the violators of it. The padrones are thoroughly organized, and no man who is at all dependent on them, and it is said there are few Italian granite cutters who are not, dares oppose them for fear of being boycotted, or even worse, in peril of their lives, if they revolted openly against their masters. It seems to us that it should not be the business alone of the union to try and check this species of slave labor, but that the padrones should be sought out and every member of the organization expatriated from this country.

The New York Fire. The report of the experts who will examine the effects of the recent disastrous fire in New York "skyscrapers" is awaited with intense interest by constructors and material men. We opine it will not present much more than is already known. That type of building is not proof against fire from without, however resistant to fire destruction it may be within. Ergo, the absolutely fire-proof building is a nonentity. The manifest duty of municipal government is to restrict the height of these structures to the limit at which the best apparatus for fire-extinguishment can effectively be used. This done, these steel structures, resting on firm foundations, and within heavy walls for the lower stories at least, will probably be as perfect buildings for commercial purposes as can be constructed.

CEMENTS AND LIMES.

White Hydraulic Cement.

Several years ago there was discovered at River Junction, Fla., a white hydraulic cement, as purely white as common lime, and therefore a rare novelty not found on the markets of either Europe or America, except as artificially manipulated at great expense. The writings of travelers, however, note the Asiatic ancients, as well as the prehistoric inhabitants of the American Rocky mountains, used a white cement in the construction of their buildings, which has endured to this day with wonderful preservation. One similar fact connected with this discovery brought to light is that the early Spanish settlers of Florida quarried this material in large quantities for the times, as the old mines in the neighborhood of their vorban earth works fortifications, located on the Apalachicola river, indicate, and tradition says they barged it down the river in a raw state to the old stone fort and settlements at St. Marks, from whence they shipped it to Havana to be calcined and ground. It was regularly reshipped back to Florida as late as the twenties, and then as the Americans took possession of the territory the traffic ceased and was soon forgotten, as Mr. John Masters, an extremely old and honorable citizen of St. Augustine, remembers.

There it was used in laying floors of houses directly on the ground, and in pointing over morter joints of walls already up, as it had been the custom there to put up the building stones with a crude lime mortar made from unsifted burnt shell that soon deteriorated, and it was thought, as this material would harden under water, it would protect the joints. Time, however, has pretty well destroyed the old brown lime mortar in the walls still remaining, but petrified the white cement, as it has done in ancient Asia and the mountains of the West. The Spaniards, however, took this material, which they had discovered near their earth works and settlements on the banks of the Apalachicola, to be a kind of gypsum or plaster of paris, and called it by the French name "Giesti."

From this it is evident that these mines, although the most recently brought to the notice of the American settler, are probably several hundred years the oldest in the United States, as there is no record when the Spaniards first opened and ceased to quarry them, or at what period they garrisoned the forts in the locality.

Besides a wall plaster and a stucco impervious to water, one of the useful articles manufactured out of this cement is a beautiful white hydraulic brick, which in time much resembles a small block of marble, but having to be made of two parts of sand to one of cement, they are in consequence too heavy for profitable transportation over long distances; hence the company will most likely leave this branch of their business to the dry pressed brick manufacturers of the country, which they will find very profitable, as the brick is very much admired for facing buildings. Experiments for durability of this material under all conditions had been successfully going on for seven years before it was discovered that the Spaniards had anticipated us. Tests for tensile strength embraced several hundred examples, which gave a mean pull of 240 pounds per square inch in thirty days (neat) and 412 pounds pull

per square inch for two parts sand and one cement in twelve months.

A plant has already been erected at this place by the Florida Cement Co., and is now in full blast, in consequence of the product being offered as cheap as any other natural cement on the market, instead of at fancy prices, as it was supposed would be the case.

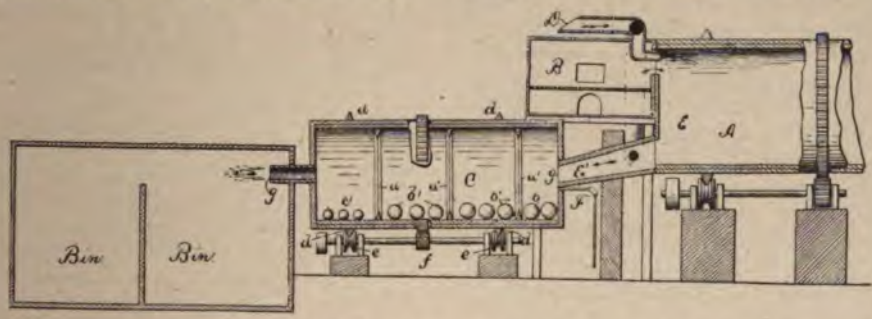
H. S. Du Val, C. E. M.

Apparatus for Burning and Grinding Lime and Cement.

Specification forming part of Letters Patent No. 611,110, issued September 20, 1898, to George Duryee of Orange, N. J.

This invention relates to an improved apparatus for the simultaneous burning and grinding of lime and cement clinker, and particularly to the curing of Portland cement. In the manufacture of Portland cement, either from clay or lime mixtures or from the natural "cement rock," so called, where the silica, alumina and lime are combined naturally, it is well known that free lime in the burned clinker, in the form of unburned lime or partially-combined lime, acts on the powdered cement seriously, often causing disintegration of the concrete or mason work. To obviate this, it is essential to air the cement from one to three months in open bins, or "cure" the cement, as it is called, to prevent slacking in the concrete work. The inventor says he has found that if hot cement clinker direct from the burning furnace is powdered while hot and dry or moist air injected into the mass while being ground the free lime is slacked at once, accomplishing in one hour what has heretofore required one to three months. Further, that the red-hot soft friable clinker is powdered with about half the power or double the speed that the same clinker requires after cooling and becoming vitreous. As this hot clinker cool quickly, it requires continuous feeding directly from the furnace where produced into the grinding-cylinder of such a furnace.

The carrying out of the invention will be described with reference to the accompanying drawing, which shows in vertical central section an apparatus suitable for carrying out the invention. A represents the lower end of a rotary burning-cylinder. B is an elevated fuel-furnace or combustion-chamber; C, the rotary grinding-cylinder; D, the hot-blast devices, located at the adjacent upper portions of the fuel-furnace and rotary burning-cylinder; E, the hot-air pipe from the hot-blast devices, entering the pipe E′, connecting the burning-cylinder with the grinding-cylinder, and F a water or steam-pipe for supplying moisture to the rotary grinding-cylinder. *a′* represents dams in the lining of the grinding-cylinder; *b′* represents large balls and *c′* smaller balls in said grinding-cylinder.



The cylinder C is preferably twenty feet long by five feet in diameter, constructed of half-inch steel plates, lined with very hard vitrified brick or other suitable lining to stand heavy friction and wear from the clinker and grinding-balls, and is mouted horizontally or slightly inclined by heavy tires *d*, resting on grooved rolls *e*, revolved by gearing *f*. An opening *g* of about fifteen inches diameter is left in each end of the rotary grinding cylinder for the feed-

ing in at the upper end and discharge of ground cement at the lower end. The cylinder ends are made strong by heavy plates of iron, and the whole inside is lined with the brick six or eight inches thick. One or more basins are formed by the projecting partitions of the lining. These basins are about sixteen inches deep and are partly filled with grinding-balls two to four inches in diameter, or preferably flint balls, two or four tons to be used, according to the size of the cylinder. Speed in grinding, about twenty-five revolutions per minute. Thus it will be seen that the grinding-cylinder is provided on its interior with a series of basins in which balls are arranged for the purpose of crushing the hot and soft clinker, relatively heavy balls being in the basin nearest to the burning-cylinder and successively lighter balls in the following basins. This grinding-cylinder is so placed in such a position regarding the rotary burning-cylinder as to allow of continuous and direct feed of clinker from rotary burning-cylinder to grinding cylinder. F is an air or steam pipe for discharging the contents of the grinding cylinder and conveying moisture thereto.

The relative positions of the rotary burning-cylinder and the rotary grinding cylinder are shown in the drawing attached hereto.

Manner of working: The grinding-cylinder is to be first filled with clinker to prevent the balls injuring the lining. When the hot clinker begins to come from the rotary burning-cylinder and enters the grinding-cylinder, the grinding-cylinder is set in motion and the air or steam pipe F opened to force the powdered cement out after doing the slaking. After starting and the process of grinding begins the only precaution necessary is to keep up proper feed of clinker, air or moisture and the process works continuously, blowing the cement out of grinding-cylinder into bins or other receptacles.

For precaution against large-sized clinker the upper basin should have large balls weighing from ten to twenty pounds each. These large lumps of clinker contain more free lime than the small vitrified clinker of wheat size. Hence when the clinker runs large, more air and moisture will be required.

The curing is hastened by a hot-air blast. Hence the hot-air blast passing through the hot-blast devices will for some clinkers be found essential, while clinkers from natural rock require moisture. The experience of the operator and analysis for free lime in the cement will determine the proceeding to be adopted. For instance, vitrified fuel-clinker containing but little free lime is easily treated by this apparatus.

Burnt Clay in Concrete.

Burnt clay has been very successfully used for ballast, and at Sioux City, Iowa, experiments were recently made with this material in concrete. According to the Clay Record, several blocks of concrete were made by using burnt ballast instead of granite chips in connection with cement, and tested very thoroughly. The experimenters are surprised at the solidty with which the cement knits to the ballast. It required the heaviest blows of a sledge hammer to break the blocks, the cement having made a perfect union with the ballast. There was nowhere any showing of pulverizing of the material, and it was evident that the product would be durable for any of the purposes to which concrete is ordinarily put.

Bronson, Mich. — Bronson's Cement Factory was the scene of quite a little excitement last week when a horse jumped into an immense vat and the whole factory shut down while the animal was hauled out, more dead than alive.

Machine To Test Road Materials.

A machine has just been received at the Johns Hopkins University which will be used by the road division of the State Geological Survey in testing the cementing power of Maryland stones with regard to their value as road material. The machine is used to compress stone dust into

a small cake, after which another machine having a small hammer, similar to a pile driver, breaks apart the stone thus cemented; the cohesive power of the stone being indicated by its resistance to the blows of the hammer.

The Michigan Cement Co., the syndicate has decided to erect works at Quincy, Mich., equal in capacity to those in Coldwater. The marl found in the lakes and lowlands southwest of that village is said to be of very superior quality and especially adapted to the making of a fine cement.

Cement Turned To Stone.

A couple of odd incidents in connection with "sky piloting" are in evidence in Redford, Mich. Elder Niles, of the Bell Branch Baptist Church, was forced to turn his hand to carpenter and mason work on account of "disease, death and desertion" in the membership of the flock, which caused the church to be unable to support a minister. About three miles from Bell Branch, but in the same township, a farmer donated a new church. The brick and cement are on the ground and a shed was built all by this one-man power; then the liberal farmer became demented and everything stopped. A car load of cement in paper bags, stored away in the church shed, gathered moisture during the late continued dampness, and is now a pile of stones covered with paper bags.

Manager Joseph Wilde, of the Western Portland Cement Mills, Yankton, S. D., said that the business of the cement company for the past year, had been entirely satisfactory so far as the output of the product is concerned and that the cement sold during the year is much in excess of the amount sold in any previous year. But the operating of the mills has been hampered all through the months of running by the scarcity of laboring men, and the amount of cement produced has not been as large as the company desired. More men could have been utilized the season through and more product turned out. The high prices paid for harvest hands attracted men away from Yankton to the north part of the state. The cement mills have been shut down for the winter.

Baltimore has twenty large firms in the lime and cement business, half of whom burn the lime used. The annual purchase of lime among the States of the South is said to be between $3,000,000 and $4,000,000 worth.

Coldwater, Mich.—The deed of the Coldwater Cement Company's property to the Michigan Portland Cement Company was recorded recently. The price named is $200,000, and stamps to the amount of $200 were used on the documents.

Demand for Cement at Washington.

The demand for Portland Cement in the District of Columbia exceeds the supply by many hundreds of pounds. Not a dealer in the city can fill the orders received, nor can they secure the material from the manufacturers. Eight or ten years ago the amount of Portland Cement used in this city did not exceed 5,000 barrels per annum. At the present time there is upwards of 100,000 barrels consumed in a year, and the end is not yet. The various uses to which it is put are constantly extending. The report comes from California that they are building houses in that state, from the foundation to the roof entirely of this product, while experiments are being carried on in different sections looking to a still more extended use of this material. Where it will end can not be foreseen at this day.—National Architect and Builder.

We understand that Mr. Bunce, of Bronson, who has the option on the marl beds located in Homer, would be ready to proceed to the erection of a $150,000 plant early next spring if the

citizens of this town would give the company which he represents a little assistance in some way, says the Homer, Mich., Vidette.

Roman Concrete Walls.

The chief objection to rubble and concrete walls is the roughness of the surface. The ancient Romans got over the objection in various ways; at first they faced them with the large blocks of tufa, such as had previously been used in the time of the kings (rubble walls only came in with the Republic); afterwards, in the latter days of the Republic and in the early Empire, they faced them with small wedge-shaped blocks of tufa; the square surfaces of those small blocks were placed diamond-wise, resembling in appearance a small net, hence called network, or reticulated work (*opus reticulatum*). Afterwards they used brick or tiles of a triangular shape, with the long surface outwards, and thus these also formed a sort of wedges, but the mortar held them so tight that even if held by the point only the brick or the block of tufa will break before it can be pulled out. The smooth surfaces are then frequently plastered and painted, or covered with marble. In building such a wall the wedge-shaped blocks or tiles were placed in order and filled up with the broken stones to the depth of about a yard before the cement or hot-lime grouting was poured in. The whole was thus bound together in one solid mass, with openings left for doors and windows.

The cement business has been rejuvinated in South Bend, Ind., this year, and the company now controlling the local plant is enjoying a good trade for a new concern.

The Portland Cement Company, near Coldwater, Mich., is getting its works under way, and the Coldwater Courier says its pay-roll has been $800 a week for two months past.

The first finished product of the Michigan Cement Company's factory, at Coldwater, was turned out Nov. 19. The clinker was of the most satisfactory character.

MACHINERY AND SUPPLIES.

[Matter appearing under this head is compiled and edited from data furnished by the advertiser, and should not be accepted as the opinion of the publishers.]

The word "patent" attached to an article implies that it is of specific excellence in one or more particulars—that it has been passed upon by expert examiners and indicated novel and of true merit. Thus when a wire rope is designated "patent steel" by so responsible and long known manufacturers as the Broderick & Bascom Rope Co., of St. Louis, it implies that the steel of which it is woven is of specific excellence, tried and tested by the best experts on what constitutes a superior material for the thing to be made of it. So by this name has the manufacturers of this "patent steel rope" conquered their enormous trade in it. Wherever wire rope transmission is extensively used, oftener than otherwise you will find the Broderick & Bascom brand.

Owing to the large increasing trade in Kruhite, Frenier & Le Blanc, Rutland, Vt., the sole American agents for that abrasive, say they are enabled to reduce the price of the material one-half cent a pound, which they claim makes it the cheapest abrasive in the market. See the corrected quotations in our Prices Current.

Think of 500 rock drills in one mining plant alone. That's the number the Ingersoll-Sergeant Drill Co. has furnished for the Anaconda copper mines. A regiment of well-drilled fellows, capable of boring enough holes in a day's shift which, when charged and exploded, would open a passage to the Plutonian regions big enough to admit all the sinners in the universe at one time. If anybody thinks that is an overdrawn calculation let them make an estimate of the work such an array of fine borers could accomplish and send us the result.

Sawing stone by means of a helicoidal wire, running like an endless band, has been of interest ever since the process was introduced. It is successful in France and Belgium, where it has been in operation many years. The European invention has been tried here, but with only partial success, however. It has not been conclusively settled that the method is worthless. Something on this order, but without the apparent faults of the foreign appliance, is what is known as the Knobel system of sawing by wire rip saws, which is installed by the New Albany Mfg Co., of New Albany, Ind. We understand this system is quite successful. The manufacturers will gladly furnish particulars to any one who is interested in that method of stone-working.

A favorite objection uttered by the proponents of hand-cutting for stone, is that the machine is not made that can cut a true circle. If anybody is in doubt of the capacity of the modern planer to cut a delicate and true circle, if they will write F. R. Patch Mfg Co., of Rutland, Vt., they can learn all about how their circular planer does it.

A "Maslin" quarry pump is a cheap affair—only in the price asked for it. In respect to its utility for quarry purposes it is at once the cheapest, handiest and simplest pump to be had. Ask "Maslins," Jersey City, N. J., for their quotations on these pumps, also for their list of second-hand appliances for quarry and shop. There's bargains to be had.

Think of a sand feed pump being run night and day for ten years and still doing duty as well as ever! That's the record of more than a few Frenier & Le Blanc pumps. The reason they give for this is that the pump runs slow, does not wear itself out as fast feeding pumps will. Reckoning from what these pumps have done, as above stated, for the ordinary gang working a few hours a day, the sand feed would last a life time. That fact demonstrated in the records the pumps have made is one reason, perhaps, why so many of the new gangs nowadays have the Frenier & Le Blanc feed attached. Another reason is that it feeds chilled shot and crushed steel as well as sand, and that the maker's guarantee goes with the machine, and the price is all right. If you intend to improve your gangs this winter consult Frenier & Le Blanc, Rutland, Vt., about their sand feed pumps.

His Soul-Despairing Cry.

Benjamin Harned, a non-union stonecutter, of Astoria, was set upon by a gang of strikers in April at Thirty-fourth street and First avenue, New York. In self-defense, he asserted, he shot and killed John Ryan. In the criminal branch of the Supreme Court fifteen strikers testified that Harned fired the fatal shot without provocation and a jury convicted him. He was arraigned for sentence before Judge Gildersleeve. Near him sat his wife and three young children. As the judge pronounced the words that doomed Harned to seven years in prison a cry of agony burst from the woman's lips, and she fel to the floor, while the children cried out in fear and horror.

Harned stood for a moment dazed. Then suddenly he turned to the judge, and with tears streaming down his face, exclaimed:

"My God, Judge, what will my children do?"

The judge could not answer the question.

SITUATIONS WANTED.

Advertisements under this heading inserted for subscribers to STONE *free of charge. Advertiser must send 25 cents to pay postage, if replies are to be addressed in care of* STONE. *Rate to non-subscribers, 10 cents per line each insertion.*

WANTED—Position; 16 years' experience as foreman and superintendent in general contract work, quarries and heavy masonry; expert on broken ashlar work. First-class references furnished. Address J. B. GORDON, Roscoe, New York.

A MAN who is thoroughly acquainted with the Granite Business in all its details, having an experience of 15 years, wishes to correspond with reliable wholesale manufacturer or quarryman regarding a situation, either for road or office position, after January 1, 1899. Correspondence confidential. Address G. B., care of STONE.

HELP WANTED.

Advertisements under this heading 10 cents per line each insertion.

HELP WANTED.—A man who thoroughly understands cutting and polishing onyx, and can take charge of a small plant. Address Editor of STONE.

HELP WANTED—Sawyer for marble and stone. Address ALBERT WEIBLEN, New Orleans, La.

TO SELL. TO BUY. TO EXCHANGE.

Advertisements inserted in this department for 15 cents per line each insertion.

FOR SALE—Nos. 2 and 3 Gates Gyratory Crushers, One 12-ton steam roller, cheap. A. N. FITZSIMMONS, 1625 Monadnock Block, Chicago, Ill.

FOR SALE—Blue Stone Quarry, located Summit, N. Y., 37 acres; also steam drill in good condition-separate or together; price low. For particulars address T. H. MAGILL, Troy, N. Y.

FOR SALE CHEAP—One Ingersoll 3½ F. Drill, mounted on quarry bar for channeling. Little used and in good running order with some steels: $200. Also, one 50 H. P. Tubular Boiler, with Blake steam feed pump; in good condition, $200. Address NAPERVILLE STONE CO.

FOR SALE—The present owner of the Dix Island Granite Quarries will sell at a reasonable price or will form a partnership with a practical quarry owner on a fair basis for th joint operation of both quarries. The stone from the Dix Island Quarries has been used in the Treasury Building in Washington and the New York and Philadelphia post offices, and is now being used by the present owner on the Metropolitan Museum of Art, New York City, the architect acceptin it in preference to all other granite submitted. Address CULLEN & DWYER, 107th and 108th streets and First avenue, New York.

FOR SALE.

Fourteen small gauge trucks.
One 8x12 eleven ton Saddle Tank Switching Locomove in first-class order.
Railway equipment of all kinds.

New Jersey Car and Equipment Co.,
Lake View, N. J.

D. W. Pratt

MACHINERY, Engines, Boilers, Rock Drills, Stone Saws, Air Compressors, Steam Pumps, Pulsometers. Hoisting Engines, Cableways, etc. Send for Special Catalogue. 211 Lucas Ave., St Louis, Mo.

FINE LOCATIONS
FOR ELEVATORS AND FACTORIES
ON THE BELT RY. OF CHICAGO.
Address B. THOMAS, Pres. & Gen. Mgr.,
Dearborn Station, Chicago.

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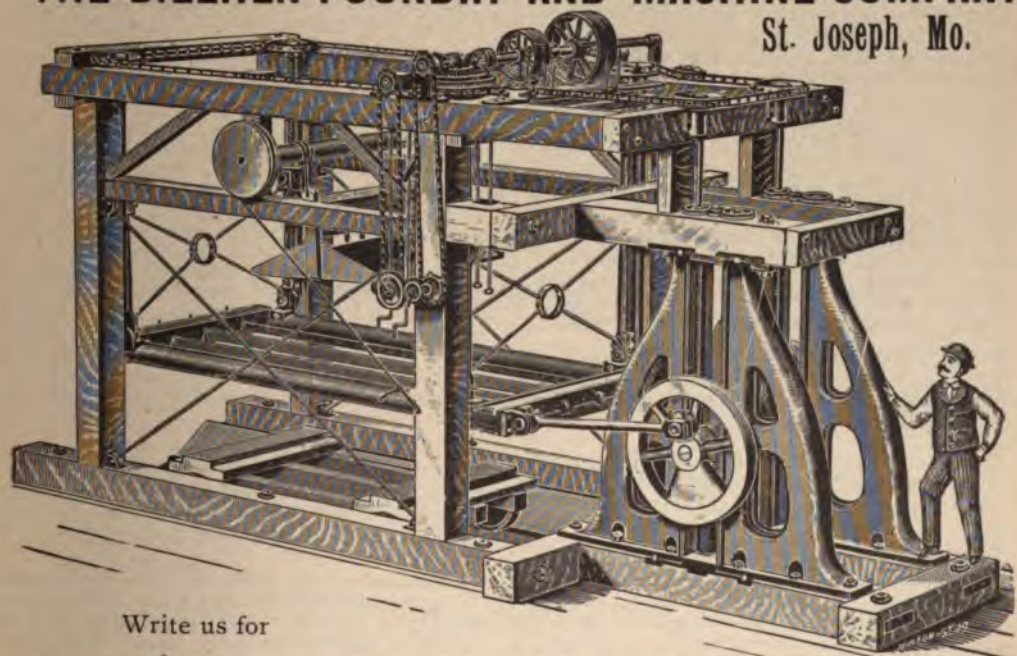

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NOTES FROM QUARRY AND SHOP.

Chambersburg, Pa.—The Franklin County Medical Society has started a movement to erect a monument in the memory of Dr. Hugh Mercer, the pioneer doctor of Franklin county, and a friend of General Washington. Dr. John Montgomery has pledged the society $100 toward the erection of a granite shaft on the public square of Mercersburg. The town was named after Dr. Mercer.

The rumored deal between Cleveland and German capitalists looking to the establishment of a cement plant at Milford, Ind., seems to have fallen through. Cleveland capitalists own a tract of land near Milford, Ind., on which are located valuable marl beds. Negotations have been pending between a German syndicate, represented by Carl Proussing, and the Cleveland owners looking to the sale of the property to the syndicate. A conference was held at Chicago but no agreement could be reached, and the deal with the German syndicate is practically off, so declared a gentlemen interested in the deal. An effort will be made, it is stated, to interest an English syndicate. The representative of the German syndicate will return to Germany.

Minneapolis, Minn. — Judge Otis has affirmed the order of Judge Harvey of the Hennepin County Probate Court in appointing a guardian for Patrick Kelly, a wealthy property owner of St. Paul. Kelly owned a large quarry on Dayton's bluff, but was found to be incompetent to handle the business on account of his failing mind. His son, Patrick Kelly, Jr., together with others, therefore, asked for a guardian. Judge Harvey appointed the St. Paul Trust Company guardian of the estate.

Fair Haven, Vt.—The Favorite Green Slate Company, which was formed six months ago, has contracted all their output for a year to the Vermont syndicate.

Elgin, Ill.—At the annual meeting of the South Elgin Stone Company William Grote was chosen president; A. B. Church, vice-president; E. D. Waldron, treasurer; David McBride, secretary; Andrew Magnus, manager.

Parties from Jackson have secured options upon nearly 500 acres of land three miles south of Brooklyn, Mich., upon which they have discovered extensive beds of marl. It is expected extensive Portland cement works will soon be erected.

An act amending the charter of the Smith Granite Company of Westerly, R. I., was passed in the state senate and house of representatives. By its provision the company may put out $300,000 of stock and $200,000 of bonds. The plan includes the purchase of the Dalbeattie Granite Works, of Niantic, R. I., of which David Mac G. Newell, of Westerly, is managing partner. The bonds will cover both properties, and will provide ample working capital for the consolidated plant. Mr. Newell will still retain an interest and has also consented to serve as manager of the company for a term of years.

Knox, Miller & Co., of Danville, Ind., have purchased the Cayuga marble and granite works of C. F. Littler & Co., and will make it a branch shop. C. F. Littler will have charge of the Cayug office.

Walton, N. Y.—It is reported that Marvin Ducher has sold out his interest in his stone quarry, located on Asbury Cables' hill, for $650 to Alonzo Seymour, of Cannonsville.

Macon, Mo.—J. P. English has purchased the marble and granite works of Thomas E. Wisdom.

Baltimore, Md.—The Monitor Lime Manufacturing Company by Joseph R. Kemp, Howard B. Shipley, John W. Devries, Charles E. Cunningham and George A. Dubreuil. The capital stock is $20,000 divided into 200 shares.

Peter Ross Company has been organized at Portland, Me., for the purpose of quarrying, cutting and dealing in stone, with $100,000 capital stock, of which $400 is paid in. The officers are: President, Peter F. Ross, of Milford, Mass.; treasurer, Peter Ross, of Milford, Mass. Certificate approved, November 14, 1898.

The Higginson Manufacturing Company, of Newburgh, N.Y.,to carry on a quarry business; capital, $250,000. Directors, H. C. Higginson, Edmund Sanxay, T. H. Millspaugh, S V. Manny and C. F. Brown, of Newburgh.

Kankakee, Ill., capitalists are now discussing the matter of starting a Portland cement factory in that city. They claim that there is no question about there being plenty of the raw material in the clays that are found in that locality.

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The firm of Shea & McGeary, granite and marble dealers, of Findlay, O., has dissolved partnership. James Shea will conduct the business at the same place.

Macon, Mo.—J. P. English recently purchased of Thomas E. Wisdom, his monument business.

Canton, O.—Samuel J. Immel has sued the Diamond Portland Cement Company to recover damages for personal injury amounting to $20,000.

The Ashley Falls Marble Company is making preparations for a large business at their quarry in Ashley Falls, Miss. One immense derrick has already been erected, and the timber for another one has arrived. A large building for tool house and blacksmith shop has been erected. The rails and ties for the switch track have arrived. Steam drills and channeling machines will be used. About fifteen men will be employed this winter, but next summer the force will be increased to 100 men.

R. Hope Hepburn, Mrs. R. Hope Hepburn, Joshua Hunt, Mrs. Volmer, Philip Volmer, T. W. Morris, S. E. Nevin, Dr. Gifford and other stockholders of the Avondale Marble Company, Avondale, Pa., have filed a bill in equity, asking for the return of certain stock held in trust, which is alleged to have been unlawfully disposed of. They also pray the court to grant a receivership for the company.

Milford, Pa.—A big sale of Pike County real estate was consummated, when the Standard Blue Stone Company, of New Jersey, purchased of Robert Muirhead, of Jersey City; John Agnew, of Paterson; and Frank Kilgour, of Passaic, about seven thousand acres of land in Lackawana, Wes fall, Shohola and Milford townships. The price paid was a trifle over $5 per acre. The town of Parker's Glen, on the Erie Railroad, is included in the transfer, also several hamlets. The new owners, it is said, will operate the numerous stone quarries on an extensive scale, employing over a hundred men.

William Alleson, a marble cutter, has had his stock of tombstones attached at East St. Louis, Ill. Many of the memorials belong to relatives of the dead sleeping in nearby cemeteries, and as they have been only partially paid for they were still in Alleson's possession. Several replevin suits will follow.

John P. Devine, of Putman, N. Y., marble and granite dealer, filed a petition in bankruptcy.

The Windsor Red Stone Company, of South Windsor, Conn., has reduced its capital from $50,000 to $25,000, but the number of shares remains the same, 500, the par of each being reduced from $100 to $50.

Des Moines, Ia.—The Oolitic Stone Company, of Indiana, has commenced suit in the district court against the International Marble and Granite Company *et al.*, to recover on an account of $111.11.

The Manhattan Concrete Company, of New York, building contractors, made an assignment. The liabilities are about $60,000 and the assets about $50,000.

Charles Gleeson will open a marble yard in Carrollton, Mo. He has not yet definitely determined on a location.

Allentown, Pa.—Frank E. Shenton, a merchant and roofing slate manufacturer of Slatedale, Pa., failed on two executions of $8,000 in favor of the H. G. Tombler Grocery Company, of Easton, and Thomas Shenton.

Detroit, Mich.—The Michigan Portland Cement Company has filed a mortgage for $1,000,000 in favor of the Central Trust Company of New York. The mortgage covers all lands and goods of the company, and is filed for the purpose of facilitating the issue of bonds. The company operate one of the largest cement factories in the world at Coldwater, Branch county. Its lands their contain an inexhaustible bed of marl.

La Crosse, Wis.—A. W. Brooks has sold his interest in the Galesville Marble Works to J. H. Hess and Albert Bartholomew. Mr. Brooks has been identified with the business for the past fifteen years.

The Granite Works at St. George, N. B., owned by Taylor Bros., have been sold to Andrew S. Baldwin and O'Brien and Gilmor.

Hoopeston, Ill.—H.D. Cash has purchased of H. G. McConnell the marble business lately conducted by McConnell & Trough.

Oskaloosa, Ia.—W. C. Spaulding & Co., the marble and granite firm, disposed of their business to DeLa and C. D. Oldham, who took possession at once.

West Chester, Pa.—Messrs. M. M. and R. E. Wood have leased and will re-open the marble works formerly conducted by A. M. Garrett and more recently by Albert L. Valentine.

The Vermont Marble Company's coping shop at Center Rutland was destroyed by fire. Loss $6,000.

Columbus, O.—Thomas H. Hames, aged 56 years, deceased. Mr. Hames was a marble cutter. He was an Englishman and single, and his home has been in Columbus since his infancy.

Kankakee, Ill.—Edward Neil Knight, president of the Kankakee Stone and Lime Company, died Dec. 1 of Bright's disease. He was 40 years old.

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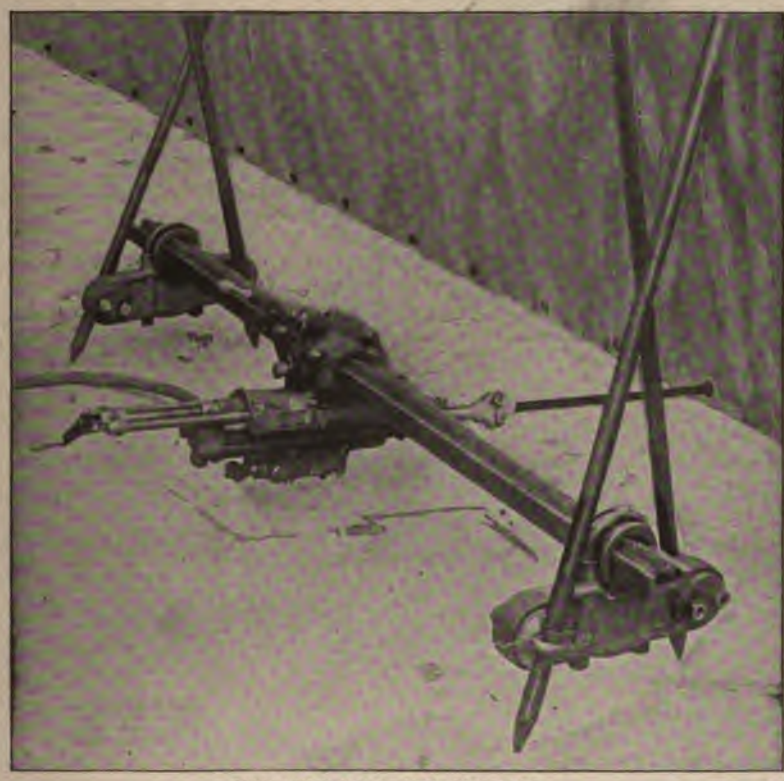

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Geo. T. Abrey is negotiating with Ohio parties for the purchase of forty acres of land on the outskirts of Owosso, Mich., under which are extensive beds of cement. The beds are ten feet in thickness, and the cement is of a fine quality. A cement factory will be built, and 1,000 men will be given employment.

Chicago real estate transfers included the sale to the Illinois Steel Company by the Cheltenham Improvement Company of a tract of land lying between Seventy-ninth and Eighty-third streets, east of Ontario avenue to Lake Michigan, for $350,000. The land adjoins on the north the company's present plant. It is known as the "Cheltenham tract," and its purchase is in connection with the general idea of expansion of operating facilities contemplated by the new Federal Steel Company, which recently absorbed the Illinois Company. On the newly bought land will be erected a cement factory, whose raw material will be the slag from the big furnaces in the steel plant. Building operations are to begin at once.

Articles of incorporation have been filed by the California Portland Cement Company, the period of incorporation being fifty years, and Los Angeles being the principal place of business. The directors are: John P. Culver and Frank H. Jackson, of Los Angeles; Ernest Waycott, Harry R. O'Brien, and Richard H. Waycott, of San Bernardino. The amount of the capital stock is $500,000, all of which has been subscribed, Ernest Waycott being the principal stockholder. There was also filed a certificate of the creation of bonded indebtedness by the company in the sum of $80,000, divided as follows: Twenty-five bonds of $1,000 each, fifty bonds of $500 each and three hundred bonds of $100 each.

Winona, Minn.—Philip Biesanz has closed his quarry for the winter and will not reopen it before spring unless good weather sets in sooner. He has completed all his contracts and is now preparing to strip a new quarry preparatory to having it ready for the removal of stone next spring.

The bed of an old lake seven miles east of La Grange, Ind., has been purchased by Chicago capitalists, who will erect a factory for the manufacture of cement and build a model town around it. The factory will have a capacity of 500 barrels of cement a day. The work of building the factory will begin as soon as an emergency switch can be constructed from either the Pennsylvania or Wabash railroads. Grove E. Norton, of 148 Dearborn avenue, who purchased the tract of land, says that a cement factory would be built. Another large piece of land has been purchased in La Grange by Michigan capitalists under the firm name of Bovee, Treat & Bunce. It is said they also intend establishing cement works.

Le Roy, N. Y.—N. B. Keeney & Son have purchased 31 acres of land in the northeastern part of the town and will at once develop another large limestone quarry. It is on the line of the B. R. & P. railroad, from which a switch will be laid. Messrs. Keeney have a two years' contract to furnish stone to blast furnaces and will employ a number of men. They eventually expect to put in a large stone crushing plant and supply stone in three grades, for street purposes, to towns and villages within 100 miles of Le Roy. This will make the second quarry this firm is operating in Le Roy. The new enterprise will be commenced at once.

The Midland Quartz Company, of Washington City, owns quarries at Broad Run, Va., on the Southern Railway, 40 miles from Alexandria. It is proposed to erect a plant for quarrying, crushing, calcining, granulating and pulverizing the stone. The quarries are five in number.

Canastota, N. Y.—It is rumored that the Solvay Soda Ash Company contemplates opening a quarry at Perryville, about seven miles south of here on the E. C. & N. branch of the Lehigh Valley Railroad.

Quincy, Mich.—The White Farm of 100 acres was transferred Dec. 2 to the Michigan Portland Cement Company. The company will at once commence work upon a plant of 1,500 barrels daily capacity The company now have 400 acres of marl and clay lands, which will supply an unlimited quantity of material.

Rockford, Ill.—A deed of voluntary assignment has been filed by the well known granite manufacturer, Charles Rundle. George W. Bresee is named as assignee. Mr. Rundle, in his efforts to compete with others, has been using some new machinery, which upon carefully watching he has found to be much more expensive than the old style of manufacturing granite work.

Massillon, O.—The property of Stansbury & Busby, monument manufacturers and liverymen, was sold by a receiver. Practically all was purchased by Mr. Stansbury and E. L. Hering, and after the sale the firm of Stansbury & Hering was organized.

A confessed judgment in the sum of $27,701 has been entered in favor of William Quigley and against the Chicago Pumice Company. The action resulted from failure to pay a note on demand. William Quigley is a resident of the Chicago Pumice Company, and the money, which was due for a long time, was ordered paid by the directors of the company. It was signed by the treasurer George Ross. Mr. Quigley lives in Cleveland, Ohio.

Cass City, Mich., is also in line for a cement factory, three capitalists, who have purchased a thousand acres of marl in the vicinity, proposing to establish one in the village in the near future.

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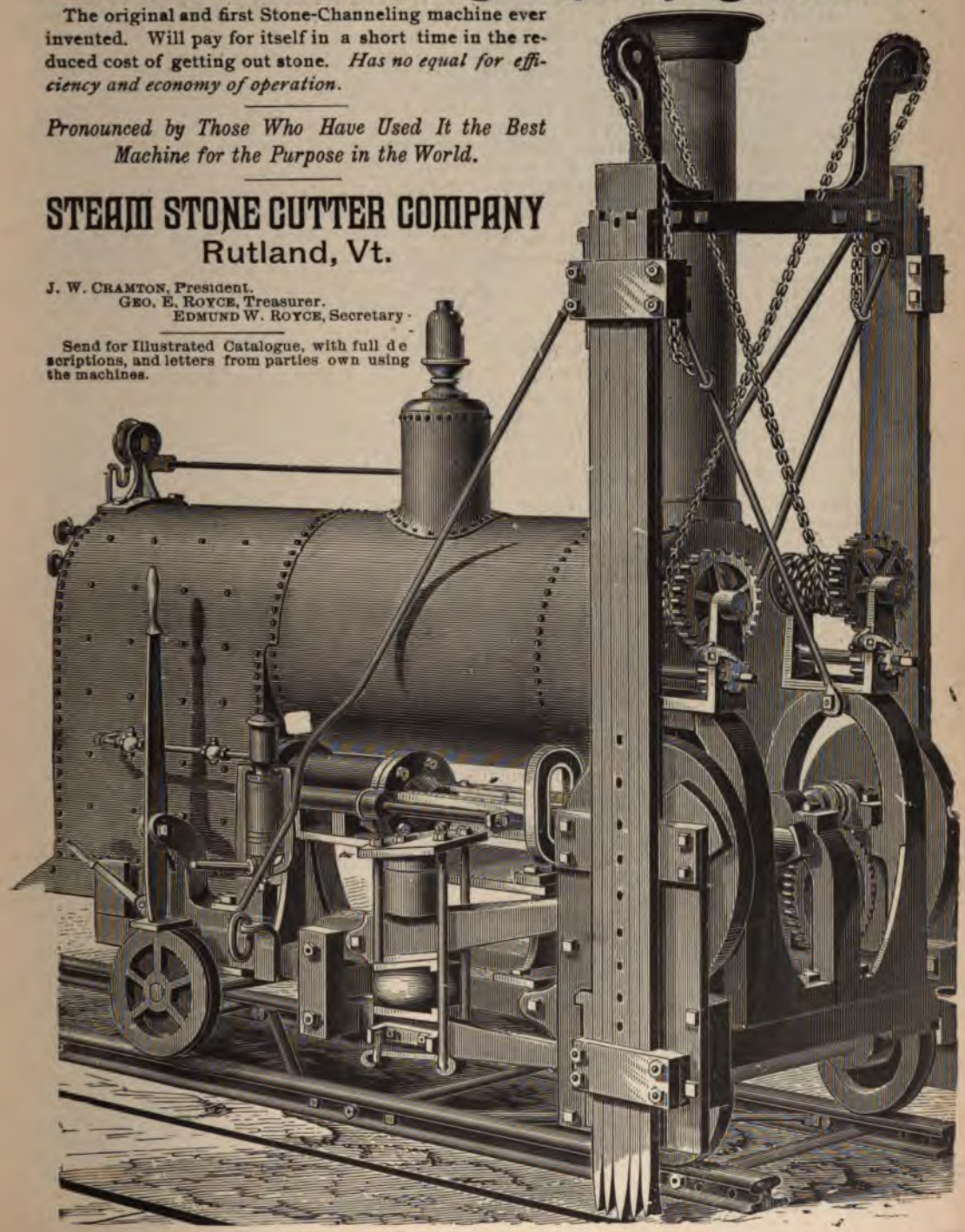

Detroit, Mich.—John Petrowski, a laborer employed in the Sibley quarries, between Wyandotte and Trenton, was killed by a blast a year ago, and Charles Schwartz, administrator of his estate has brought a suit against the Sibley Quarry Co. for damages in the sum of $10,000.

Pittsburg, Pa.—Robert E. Actor and five others entered equity suits against the Union Brick and Stone Company, Limited, Edward Soles and Daniel Stratton. An injunction is asked to restrain the defendants from disposing of the property of the concern in Lincoln township. The plaintiffs have liens for wages against the company amounting to $409.63.

Knox, Miller & Co., of Danville, Ill., have purchased the Cayuga Marble Works of that town, and will make it a branch shop. The Cayuga branch will be under the management of Charles F. Littler, of Cayuga.

John W. Shirick has bought a valuable bluestone quarry at Lanesboro, Pa., and intends to make that his home.

Veteran, N. Y.—Martin Dunn has sold his quarry to Thomas O'Rourke; it is reported that Mr. Dunn and John Bailey will open another one soon.

Altoona, Pa.—The Clover Creek Limestone Company with headquarters at Williamsburg, Blair County, has executed a bill of sale of its branch railroad, three miles in length, to the Manor Real Estate and Trust Company for $42,107. The company has sold its quarry interests in Woodberry township to the Manor Real Estate and Trust Company.

Macomb, Ill.—Mrs. O. D. Doland makes the announcement that the business of her late husband will be continued as heretofore under the same name—Macomb Marble and Granite Works. R. T. Quin will act as manager.

Coldwater, Mich.—The Ewing Monumental Works is the name adopted by the successors of the late Charles Ewing.

Oakland, Cal.—Articles of incorporation were filed by the Shasta Slate Company, with principal place of business in this city. The purposes as set forth are to buy, sell, own and operate mines and quarries of slate deposits, mills, sites, hotel business, lighting and transportation. The directors are W. J. Dingee, F. J. Woodward, W. A. Winsboro, F. A. Lash and Walter C. Beatie. The capital stock is given as $100,000, with $2,400 actually subscribed.

The Souhegan Quarrying Company, of Milford, N. H., and the Silsby & Johnson Company, of Newport, N. H., have filed articles of incorporation with the secretary of state.

Kankakee, Ill.—The Donald Sinclair Construction Company has been incorporated with a capital stock of $30,000 for the business of ditching, general excavating, quarrying and contract work. The incorporators are A. I. Young, James A. Sinclair and Donald Sinclair, who are elected as directors for one, two and three years respectively. The stock of the company is divided equally among the three incorporators.

Valuable deposits of limstone have been located in Winfield township, Butler County, Pa., and it is said that sixteen other townships abound in large quantities of limestone. This may open up a new industry in Butler County.

The stockholders of the Sandusky (O.) Stone Company have been offered $22,000 for their property, consisting of about 140 acres, by the Lorain Steel Company. The land is situated on Campbell street, south of Sandusky, in Perkins township. It contains a well developed quarry, and the stone secured is of a quality that is desired by steel manufacturers at the furnaces.

Warren, O.—The Hamilton & Dailey stone quarry, in Brookfield township, has resumed operations, after and idleness of several months.

The employes of the Bangor Valley and Bowers & Mutton slate quarries, at Bangor, Pa., who went on a strike against a cut of 10 per cent. in their wages, have accepted the reduction and returned to work.

In the matter of the bondholders against the Bangor Superior Slate Company, of Bangor, Pa., the rule to show cause why the trustees should not proceed to sell the property was discharged by court at Easton.

Tuscumbia, Ala.—Capt. James J. Bowser died unexpectedly November 13. The deceased was 65 years of age, and for the last twenty-five years or more has had charge of Government stone quarries in this portion of the State.

Thomas J. Brennan, a stone dealer, 40 years old, of 8 West Ninety-ninth street, New York, died November 12, of Bright's disease.

Macomb, Ill.—Orrin D. Doland, formerly connected with the Richter & Doland marble works of Springfield, Ill., but for the past three years resided at Macomb, died November 2.

St. Louis, Mo.—John Reith, a contracting stone mason, put a bullet in his brain. He died eight hours later, without regaining consciousness. The only reason that can be assigned for the act is that business worry unbalanced his mind.

William Wallace Whitmore, one of the leading business men of Lockport, N. Y., died at the advanced age of 88 years. Mr. Whitmore owned extensive stone quarries.

Dayton, O.—Taylor Barnes, deceased. He was salesman for Staniland's marble firm for years.

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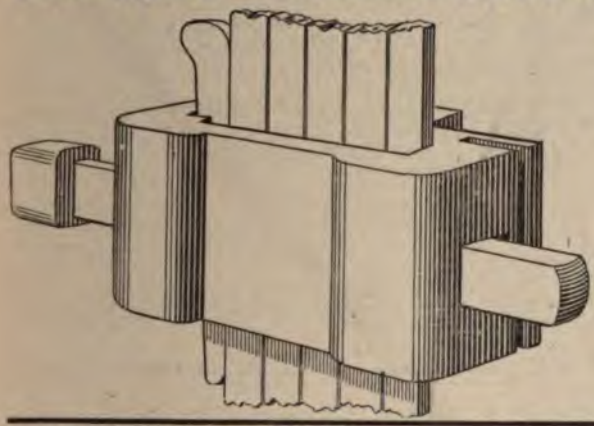

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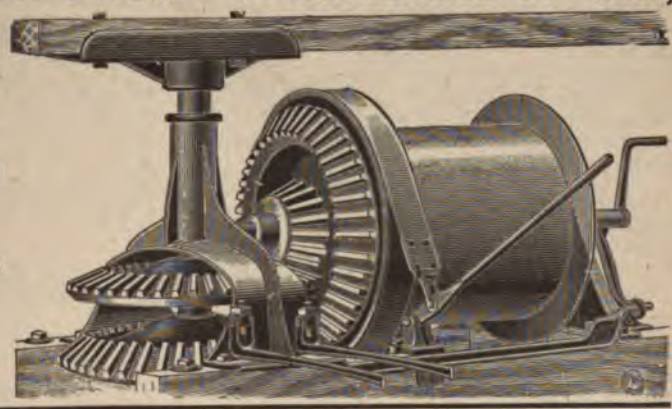

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It is reported that a Michigan syndicate proposes to invest nearly a half million dollars in a cement factory at South Bend, Ind. It is expected to secure a fine grade of marl from Chain Lakes, five miles from that city, and careful tests show that the quality and quantity are eminently satisfactory. Options have been secured on the necessary territory.

G. A. Craig, of Toledo, connected with the Craig Stone Quarry, of Sherrodsburg, O., says that they have more orders than they can fill. The company will double the capacity of the quarry next year, and place a new sixty-horse power boiler and two new jacks for the derricks. A new office building and engine room are being built.

Lake Charles, La.—D. C. Kimball has rented a building in Jennings, and established a marble shop there.

The Chippewa Sand and Stone Company's sand mill at Massillon, O., was totally destroyed by fire. The mill was located at the quarry near Warwick and within a few feet of the B. & O. main track. A spark from an engine undoubtedly caused the conflagration. The mill was leased by Messrs. H. W. Loeffler and Edward Ruch, of Massillon, from F. J. Hurxthal, of Canton, and while the former's loss will probably reach about $1,800, the loss sustained by Mr. Hurxthal will amount to about $11,000. The interests of both parties were but partly covered by insurance.

Canonsburg, Pa.—The fire which swept this town November 14, destroyed R. H. Black's marble works, loss $4,000, insured.

Trenton, N. J.—A verdict of no cause for action was rendered in the United States District Court in the suit for $40,000 of James A. Phelps, receiver of the Metropolitan Marble Company against the Church Our Lady Help of Christians, of East Orange. The suit was for damages for a breach of a $53,000 contract for furnishing marble for building the church. There was but a small quantity of marble furnished and $13,000 had been paid on account, when the company went into the hands of a receiver. The company's plant was bought by the church corporation in order, it is claimed, to secure a continuation of the supply of the same kind of marble, as had been used on the church so far built.

An execution for $1,500 has been issued by Arthur Benson and G. A. Jaker, trustees, against the real estate of the Globe Hard Vein Slate Company, at Edelman's, Pa. The Globe quarry has not been operated for several years.

Cass City, Mich.—Montague, Graves & Benham have secured leases and options upon 1,000 acres of land in this vicinity with the intention of establishing a plant for the manufacture of cement and fertilizer.

Chicago.—Chicago Onyx & Manufacturing Co., stone-yard and lease. Chattel mortgage, $5,100.

Tweed, Manitoba.—The Portland cement works at the village of Marlbank, on the Bay of Quinte railway, are to be re-opened after five years of suspended operations. They were then owned by Englishmen, but the stock has been purchased by a Montrealer, who will expend $50,000 in erecting buildings and kilns and in the purchase of machinery. Thirty men are at work, and operations will be resumed in March next.

Coldwater, Mich.—Samuel Beard, of Lansing, expects to move his family here early in December and open a marble yard.

Sheffield, Ala.—The T. L. Fossick Company are opening another rock quarry east of Russellville. They will build a branch road from the Northern Alabama.

A new stone quarry is likely to be opened at Industry, Pa.

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BOOKS AND PERIODICALS.

ROUNDABOUT RAMBLES IN NORTHERN EUROPE," by Charles F. King Author of "The Land We Live In" "This Continent of Ours" etc. Cloth; 238 Engravings, Lee & Shepard, Publishers, Boston. Price, $1.25.

In this beautifully illustrated volume the author gives an account of the travels of the Cartmell family, consisting of Mr. and Mrs. Cartmel, their four children, and governess, through Great Britain, Norway, Sweden, Denmark, and Russia. Great Britain, being so closely connected with our country by language, history, and ancestry, possessed unusual attractions for them, and they spent nearly a year in visiting that country. They are natural travelers in search of the beautiful, the interesting, and the wonderful, their great object in journeying being pleasure and education. The work is written in the narrative form and no effort has been spared to have the information given correct and up to date, so that the book may be a safe guide to travellers. The illustrations, of which there are 238, are half tones reproduced from photographs. A list of the best books to be consulted, as well as a list of poems connected with the places described, is given at the close of the volume.

The Pope Mfg. Co., of Hartford, Conn., has issued the Columbia Desk-pad Calendar for 1899. This handy reminder has been for years one of the most pleasing of special advertising features. We note that the new calendar is very similar in design and make-up to the 1898 calendar, although it has more artistic covers and is more profusely illustrated.

Any person may obtain a copy by applying to the nearest Columbia dealer or by sending five 2-cent stamps to the calendar Department, Pope Mfg. Co., Hartford, Conn.

In the American Monthly Review of Reviews for December the editor reviews the November elections, the progress of our peace negotiations with Spain, and other matters of national and international moment. Some very suggestive and interesting cartoons from recent issues of the Spanish journals are reproduced.

The complete novel in the December issue of Lippincott's is by Annie Eliza Brand, and has its action mainly in London. "Mrs. Russell's Sister" is a young, well-to-do, and attractive widow, who takes a small house in a back street with a view to benefiting her humbler neighbors; but her philanthropic efforts are apt to require masculine assistance, and all her rtitude cannot keep her lovers at a distance. Other contents are Philadelphia a Century Ago, by Kate Mason Rowland; Noblesse Oblige (poem), by Mary E. Stickney; Lincoln of Coyote, by James T. McKay; The Champion (poem), by Francis Sterne Palmer; Babylon the Great, by Austin Bierbower; Table Sundries, by Calvin Dill Wilson; Stability (couplet), by Grace F. Pennypacker; Nobody's Fool, by L. S. Berard; Signature in Newspapers, by Alfred Balch; Sacred (quatrain), by Carrie Blake Morgan; Verona, by William Stevens Perry; Six Weeks on the Stage, by Charlotte Adams; Rudolf's Decision, by Frederic M. Bird.

"SIX YOUNG HUNTERS OR THE ADVENTURES OF THE GREYHOUND CLUB, by W. Gordon Parker, Author of "Grant Burton" etc. With illustrations by the author. Cloth. Lee & Shepard, publishers, Boston. Price, $1.25

The scene of the story is laid in Indian Territory, where a party of boys from the East are spending the summer vacation at a lodge owned by the uncle of one of them. Here the boys engage in various sports; hunting, fishing, and coursing with hounds; but their most thrilling adventures come from the proximity of a body of outlaws who were in hiding near the lodge. What the adventures were we leave to the readers to find out, but can assure them that the book abounds in lively descriptions of their fortunes and misfortunes which will intensely interest any live boy. The book is healthy in tone; the boys are manly, honest, and of good principles; and the scene is laid in a comparatively new and interesting country.

"PAULINE WYMAN." By Sophie May, Author of "The Doctor's Daughter" "The Asbury Twins" "Quinnebasset Girls" "Our Helen" etc. Cloth. Illustrated. Lee & Shepard, Publishers, Boston. Price, $1.25.

"Sophie May" writes with a remarkable insight into the thought and life of girls, and shows an unaffected sympathy in the perplexities, aspirations, and dissappointments of their experience. All of her characters are naturally drawn and skillfully placed in scenes that are described as only such an author can whose study of girlhood has been thorough and exhaustive. In "Pauline Wyman" the author has drawn a typical New England girl whose strong and beautiful character is developed by her environment. How she overcomes unfavorable surroundings, her experience in teaching school, the interesting circumstances in a young girl's life, are all told with the same orginality and freshness which have drawn a multitude of young people to the author's previous work in the "Quinnebasset Series," and will be followed by the reader with unflagging interest.

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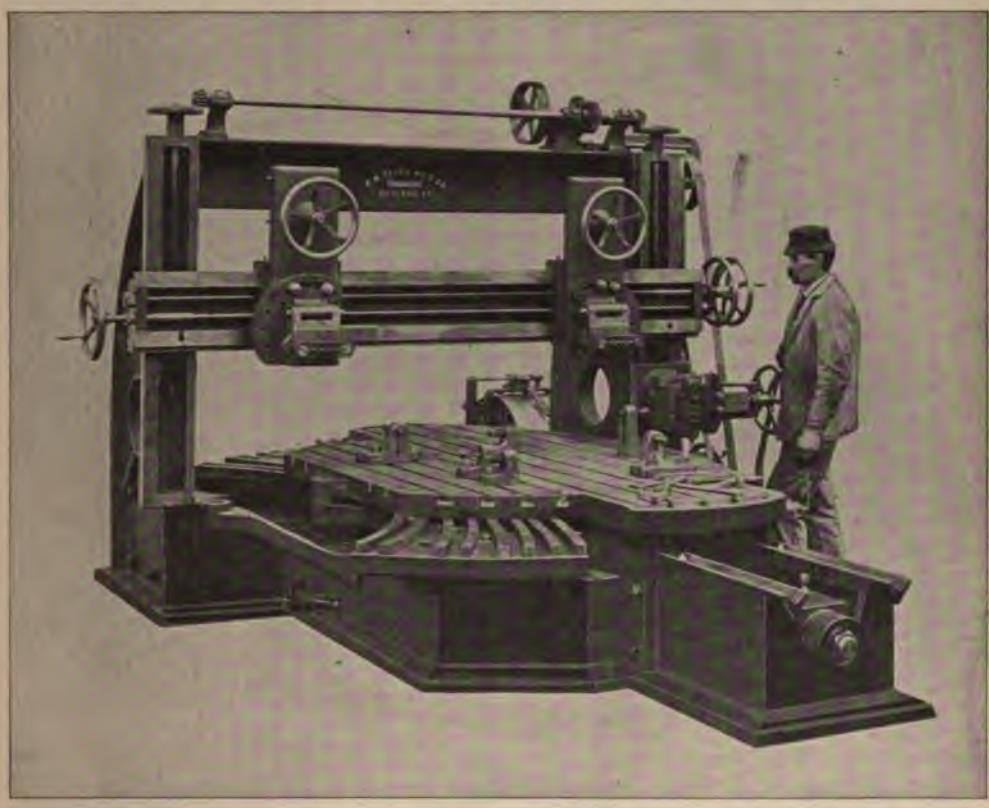

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CONTRACT NEWS.

Peru, Ind.—The Presbyterian Society has under consideration plans for the erection of a $15,000 church. Rev. Harry Nyce.

Calodonia, Minn.—The St. John Catholic Society propose to build a $15,000 church in the spring.

Eaton, O.—The P. C. C. & St. L. Ry. has made an appropriation of $8,000 for the erection of a depot at Eaton.

Grand Rapids, Mich.—The school board has under consideration plans and specifications for a new library building.

Carnegie, Pa.—The citizens are selecting a site for the proposed new Carnegie Library which Andrew Carnegie proposes to erect here.

Garner, Ia.—The contract for building the court house will be let December 15. A certified check for $800 required. H. V. Reed, county auditor.

St. Joseph, Mo.—The Christian Science Society has decided to commence work on the erection of a new church.

McKeesport, Pa.—The First Baptist Society is taking the first steps towards the erection of a new church.

Chattanooga, Tenn.—The Southern Methodist Church has decided to build a $10,000 church. Rev. J. O. Straley, Pastor.

Rockford, Ill.—The council will be urged to make an appropriation for a new city hall.

Macon, Mo.—The question of building a new jail in Macon County is being agitated.

Des Moines, Ia.—Chas. A. Frost, Pullman Bldg., Chicago, is preparing plans for a $200,000 station to be erected by the Rock Island Co., at Des Moines.

Phœnix, Ariz.—Sealed proposals will be received January 10, 1890, for the erection of a capitol building for the Territory of Arizona, according to plans and specifications of James Rioly Gordon, architect, San Antonio, Tex. Copies of said plans and specifications will be on file at the office of the commission on and after December 10, 1898. Each proposal must be accompanied by a certified check for $5,000. H. B. Gage, chairman, F. H. Parker, secretary.

Shelton, Conn.—The Episcopal Society of the Good Shepherd is preparing to build a $30,000 church. Plans have been accepted. Rev. F. H. Mathison.

Utica, N. Y.—Jesse L. Oberdorfer, manager of the Utica opera house is planning to build a $60,000 theatre. Plans are not yet prepared. It is proposed to break ground May 1.

Washington, Pa.—The Cumberland Presbyterian Society has purchased a site for the erection of a new church.

Evansville, Ind.—The Jeffersonville Avenue Cumberland Presbyterian church society will secure plans for building a $15,000 church. Rev. T. Ashburn, Pastor.

Denison, Ia.—The Northwestern Railway proposes to build a $40,000 depot at Denison in the Spring.

Madison, Minn.—The county commissioners of Lacqui-parle County are considering plans for a new court house.

Wichita, Kans.—The Unitarian Society has plans under consideration for the erection of a new church.

Norfolk, Va.—The United States Government made extensive purchases for naval purposes. It is intended to construct on this property the new $2,000,000 dry dock.

Baltimore, Md.—The alumni of St. Mary's Seminary have decided to build a new chapel at a cost of $75,000. Ground will be broken in the early spring. Rev. A. L. Magnien, president of St. Mary's Seminary.

McKees Rocks, Pa.—The St. Francis Catholic Society will build a modern church. Plans have been proposed by Elise Mercer, Pittsburg. Rev. Chas. Coyne, rector.

Brownville, Tenn.—Money is being raised to rebuild the Methodist Church recently burned. Cost $20,000. Rev. T. J. Newell.

Sea Isle City, N. J.—The Sisters of St. Joseph will build a $30,000 school building. Otto C. Wolf, 1345 Arch St., Philadelphia, architect.

Sandusky, O.— The Calvary Episcopal Society of the Good Shepherd is preparing to build a commodious church. Rev. E. V. Shayler, rector.

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Secor, Ill.—A large iron bridge is to be placed on the T., P. W. Railway one mile east of town.

Amherst, Wis.—A new steel bridge is to be built across Duck Creek by the Green Bay and Western road soon.

Rock Island, Ill.—The bids for the erection of a new bridge to be built by the government across Rock River to replace the old one, has been awarded to the J. G. Wagner Co., of Milwaukee. The bridge will cost $25,000.

Abbeville, Ga.—The Wilcox County Board will soon ask for bids for the proposed court house. Estimated cost $20,000. Plans prepared by Andrew J. Bryan & Co., Atlanta.

Chester, Pa.—The plan adopted by St. Paul's new church committee contemplates a very fine structure, and as soon as it is modified in a few particulars by the architects, Messrs. Geo. W. Mattress & Son of Philadelphia, the specifications will be presented to the contractors and bids will be invited. Rev. Francis M. Taitt, rector.

MONUMENTS.

John Hyland, of Dansville, N. Y., has made an offer to the soldiers' monument committee of that place, to the effect that he will give $1,500 towards the erection of a soldiers' monument, providing another $1,500 be raised.

Marquette, Mich. — A movement is being organized among the members of the Thirty-fourth Michigan Volunteer Infantry to erect a monument to the memory of Dr. Bobb, of Calumet, who died at sea en route to the United States from Cuba.

Baltimore, Md.—The monument committee of the Sons of the American Revolution determined to proceed with the erection of a monument to the Maryland patriots. A subcommittee upon ways and means of securing increase of the funds for the purpose of the monument, consists of Gen. Joseph L. Brent, Mr. Samuel H. Shriver, Mr. Edgar G. Miller, Hon. James A. Gary and Mr. Douglas H. Thomas.

Champaign, Ill.—The trustees of the University of Illinois selected a prominent spot on the college grounds for the interment of Dr. John Milton Gregory, first president of the institution, whose body lies here in a vault at Mount Hope cemetery. They will erect a granite monument to his memory, the body being deposited in a vault in its base. The pedestal will be surmounted by a bronze statue provided by the alumni association of the university. Trustees S. A. Bullard of Springfield, J. S. Raymond of Sidney and Lucy L. Flower of Chicago, are appointed a committee to carry out the wishes of the board in respect to the construction of the monument.

Shenandoah, Iowa.—The Chicago, Burlington & Quincy road is preparing to build a 24x116 depot equipped with all modern improvements. W. C. Brown, general manager, Chicago, Ill.

Newport News, Va.—The First Presbyterian Society will build a $20,000 church. Rev. E. T. Wellford, pastor.

Waynesboro, Pa.—The M. E. Society have accepted plans for building a $15,000 church. Rev. C. V. Hartzell, pastor.

Monticello, N. Y.—The St. Peter's Catholic Society has secured plans for building a $28,000 church. Rev. J. F. Raywood, rector.

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St. Louis, Mo.—Plans are being prepared by Fred Rauket, 99 Metropolitan Block, for an $85,000 brewing plant to be erected by the Union Brewing Co. The building will be equipped with engines, boilers, dynamos, etc.

Milwaukee, Wis.—The Kreckhofer Co., manufacturers of freight elevators, has purchased additional land joining its present plant, and a series of buildings, five stories in height, to cost $150,000, will be erected in the near future.

Coshocton, O.—Plans and specifications have been prepared for building a passenger station by the Pan Handle Railway.

Atlanta, Ga.—The Presbyterian Society is arranging to build a $30,000 church. Walter P. Inman, 478 Peachtree St. can be addressed.

Cedar Falls, Iowa.—The Council has decided to submit to the voters the question of issuing $125,000 city hall bonds.

Decorah, Ia.—The Winnesheik County citizens have voted to issue $75,000 court house bonds.

Waterloo, Iowa.—The citizens of Blackhawk Co. have voted to issue $75,000 court house bonds.

Janesville, Wis.—Rock County voted to erect a new jail at a cost not to exceed $25,000. Plans and specifications will be presented at the January meeting of the board.

Peoria, Ill.—An ordinance was passed granting certain rights to the Rock Island road, providing a $50,000 depot be erected.

Janesville, Wis.—The Chicago, Milwaukee & St. Paul railroad company will commence work on their new passenger station in this city just as soon as the frost is out of the ground in the spring. Estimated cost $25.000.

Indianapolis, Ind.—Preliminary plans are being prepared by D. A. Bohlen & Sons for a theatre and hotel building to be erected at Alabama and Washington streets.

Lynchburg, Va.—The First Presbyterian Society has taken steps towards the erection of a $28,000 church.

New Haven, Conn.—Wm. H. Allen has prepared plans for a $25,000 church to be erected by Plymouth Church congregation. The building committee consists of E. Bryan, Chas. A. Ferry, Andrew C. Smith, Geo. T. Bradley, and Geo. A. Saunders.

Palestine, Tex.—The State Comptroller has registered $24,000 city hall and jail bonds, and $12,500 school bonds.

Yates Center, Kan.—$30,000 in bonds have been voted for the erection of a court house.

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VOLUME XVIII. JANUARY, 1899. NUMBER 2.

THE NEW PUBLIC LI

THE FOUNDATION OF THE U. S. GOVERNMENT POSTOFFICE AND CUSTOM HOUSE BUILDING AT CHICAGO.*

BEFORE beginning the description of the foundations of the Chicago postoffice building your attention is invited to a statement of the kinds of material met with in constructing them. This will facilitate a clear understanding of the merits of the plans devised; the reasons for their adoption and the methods employed in the execution of the work.

The City of Chicago stands upon a flat plane. The materials underlying it are as shown on accompanying sections. (Fig. 440.)

Commencing at the surface where this has not been disturbed there is about one foot of black soil. Below this there is a stratum of rather fine sand from six to eight feet in thickness near the Lake, and growing thinner westwardly until it disappears. Under this sand where it is found, and beneath the black soil where the sand does not occur, there is a stratum of stiff, moderately hard clay, from three to eight or ten feet thick. And from the bottom of this hard clay to a depth of from forty to sixty feet below city datum (low water Lake level) the material is very soft clay, saturated with water, with now and then a thin stratum of firmer clay, usually not more than two or three feet in thickness. At the bottom of this very soft clay, at a depth of from forty to sixty feet below city datum, the clay becomes hard and mixed with a small and gradually increasing percentage of sand and gravel, changing into a genuine hardpan within the first three or four feet. This hard pan is so hard that it cannot be penetrated with the common wood auger usually employed in making borings; and when it is desirable to go deeper with a test-hole, resort must be had to a drill.

It is from six to thirty feet in thickness, and rests upon a solid bed of limestone lying at a depth below city datum of from sixty to ninety feet.

In making excavations for the foundations of large buildings in Chicago they are generally carried down from ten to fifteen feet below curb grade. This means the removal of the soil and sand at the surface and a portion of the hard clay below.

From this description of the materials underlying the site of the city it is hoped that a clear understanding may be gained of the circumstances which exist and the conditions which must be considered and complied with in designing the foundations of heavy buildings in Chicago.

Experiments repeatedly and carefully made by loading the soft clay found at the bottom of the proposed basement floors show that it begins to yield un-

*A paper read before the Western Society of Engineers, Sept. 28, 1898, reprint from the Journal of the Society.

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ACCEPTED DESIGN FOR U. S. GOVERNMENT POST OFFICE AND CUSTOM HOUSE.
CHICAGO.

Henry Ives Cobb, Architect. *Wm. Sooy Smith, Engineer in charge.*

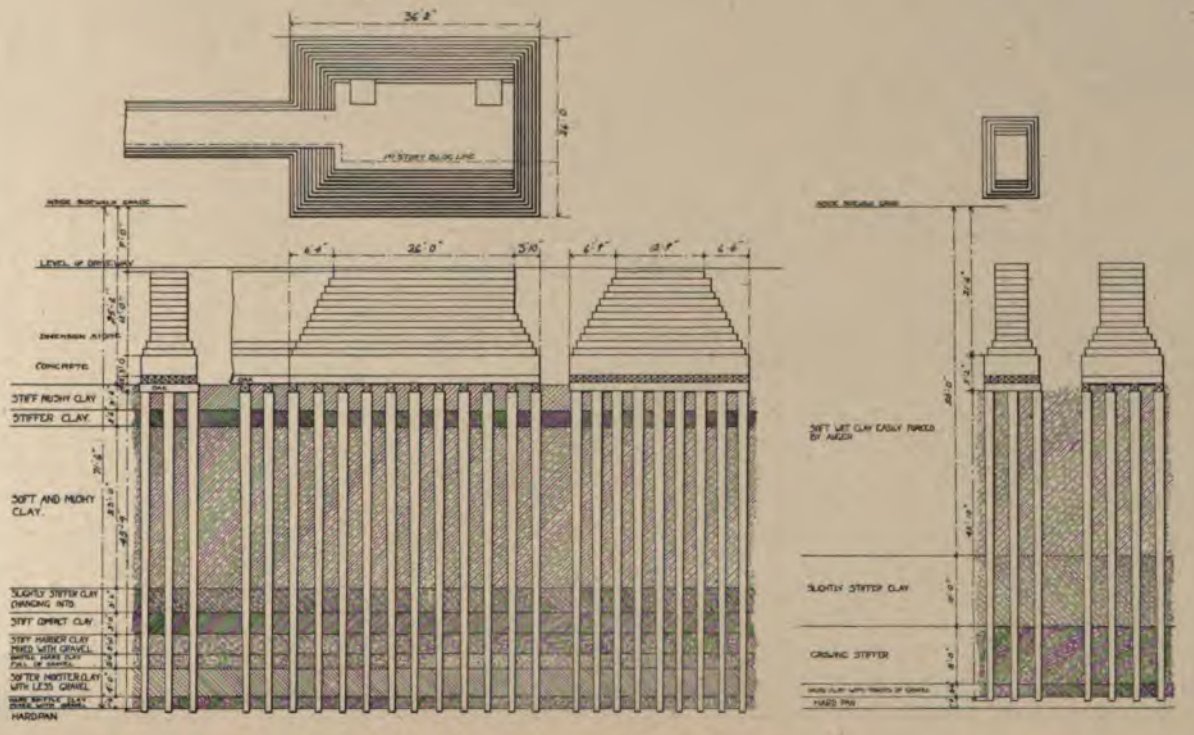
der loads varying from three to four thousand pounds per square foot. But if these loads remain, the settlements which take place will appear to cease during the time commonly occupied by the experiments. If the loads are increased much beyond four thousand pounds, the settlements do not cease, but seem to go on continuously, though at a gradually diminishing rate. And in many instances in which buildings have been erected on foundations covering such areas as to make the loads carried by the soil well within the limit of 4,000 pounds per square foot, these buildings have within a few years from their completion settled and cracked badly. These settlements have been so slow that they could only have been detected and acurately measured by levels carefully taken at long intervals. Such levels taken on the Board of Trade building during six years showed a total maximum settlement of 16½ inches and minimum of 8 inches. which caused it to crack so badly that parts of it had to be taken down. The average settlement was 12¼ inches in six years, 2 1-24 inches in one year, or only about ½ of an inch per month. From which it must appear that those who built in accordance with the teachings of the experiments made were pardonable for the costly errors that resulted from ignorance of this insidious peculiarity of the soil which no experiment had revealed.

The simple fact is that there is a gradual settlement that goes on during long periods under loads less than those which the soil will sustain temporarily. This probably results from the gradual squeezing out of the water in the clay through its infinitesimal interstices by the superincumbent loads. As the time during which this movement of the water takes place increases, the velocity and resistance from friction diminish, and as the water disappears the clay is more easily compressed, and hence this slow settlement. In confirmation of this theory it is found, where excavations are made of soil that has been long loaded, it is found compressed and partially dried to a considerable depth below the loads. Nothing but very close and accurate observations and measurements made through a term of years can determine just what is the maximum safe load that this soil will sustain permanently; and as there is considerable variation in the character of the materials at different places, it would seem very difficult if not impossible to fix upon any load that could be considered safe, which would not be so small as to be of no use in planning foundations.

In the case of the foundation of our government post office and custom house building, which are under consideration, all the controlling circumstances seemed to lead to the designs that were adopted, and which have now been carried out to completion without a single serious difficulty or accident, by the McArthur Bros. Co., contractors.

The building is to be monumental in its character. The appropriation made by the government for its construction is munificent, amply providing for building the magnificent edifice that it will be, after the very best methods, especially such as will absolutely insure its greatest durability. The plans by Mr. Henry Ives Cobb, architect, seem models of correct design, adapting each part of the building to its purposes and providing amply for all requirements with a minimum quantity of materials.

The weight of the building will be very great, amounting to about 150,000 tons. The several methods of construction of the foundations studied and compared were:



DETAILS OF FOUNDATION PIERS

FIG. 1.

1st, Masonry on platforms of steel beams and concrete.

2d, Wells sunk to hard pan and filled with concrete or rubble masonry.

3d, Piles driven to hard pan, wooden grillage concrete and masonry.

The first method was rejected because unsafe and too expensive. The second method, though deemed perfectly safe and reliable, was from careful estimates found to be unnecessarily expensive for this site. The third method, with piles, timber platforms, concrete and masonry, was adopted as being free from any danger of settlement and less expensive than either the first or second methods.

The piles are so many posts resting on an unyielding bottom and sustained from lateral flexure by the pressure of the surrounding materials. thus affording positive suppport for the loads they carry and transmitting them directly to hard bottom.

The maximum load to be carried by pile was arrived at by reference to a great many examples of old structures on pile foundations in similar materials, notably some of the London bridges across the Thames and bridges across the Seine in Paris, in which the piles are loaded to sixty tons each and even to one hundred tons in one of the latter. Also by calculating the sustaining power of piles of the same kind used in the foundations of the public library and other very heavy buildings in Chicago. During the construction of the foundation for the public library building I loaded one of the piles with all the pig iron that could be stacked on it conveniently (fifty-three tons), and had this load left on it for weeks, without producing any settlement, after the first subsidence due to the elasticity of the pile. The application of Trautwine's formula to the piles in the foundation of the post office building since they have been driven, shows the load adopted of thirty tons (each)to be perfectly safe.

Preliminary borings made for the purpose of determining the quality of soil underlying the site of proposed building, resulted as follows: (See also Fig. 1.) After boring through the filled material and sandy soil for about twelve feet below surface of street, a layer of hard brittle clay, about three feet thick, was struck. Below this to a depth of from 55 to 60 feet below street level the clay was very soft, with spots of stiffer clay, and traces of gravel in places, but nowhere firm enough to sustain any considerable load. From the depth of 55 to 60 feet the material grew harder gradually, with more gravel, until at the depth of from 60½ to 71½ feet below the street level, hard pan was struck, into which it was impossible to bore with a common wood augur.

From the borings it was determined that the length of the piles in the foundations, to be cut off 26½ feet below street level, would be from 43 to 45 feet, provided they were driven to hard pan, so the plans were made for 50 foot piles, to allow for slight irregularities in the top surface of the hard pan and the sawing off.

Excavations to a depth of 30 feet below street grade verified these borings to that depth. The material is a blue, plastic clay, weighing 136 pounds per cubic foot. It contains some pockets of coarse sand and a few boulders of various sizes.

The piles driven with square ends without sharpening are cut off 26½ feet below street level or 12½ feet below low water level of the lake. The thickness of the caps 14 inches added to that of the platform resting on them 12 inches

thick, brings the top of the platform 2 feet 2 inches above the tops of the piles and 10 feet 4 inches below lake surface at low water, insuring perpetual immersion of the highest timbers in the foundation and hence everlasting durability.

The foundations would have cost considerably less if the piles had been cut off eight feet higher and the timbers would still have been 2 feet 4 inches below lake surface and so perpetually wet. But in view of the possible disturbance of the foundations by the construction of subways in the streets, or by any other deep excavations in the immediate neighborhood made for any purpose, it was deemed best to cut the piles off at the lower level determined upon.

There are 5,087 piles, including 59 under the foundations for subtreasury vaults. (See general plan of south half of foundations Fig. 2.) They are of Norway pine, not less than 16 inches in diameter at the butt, and 10 inches at the point. They were driven by a steam hammer, the falling part of which weighs 4,700 pounds and drops 42 inches. The hammer frame and engine weigh 4,500 pounds. They were driven until it required from 6 to 8 blows of the hammer to drive the pile one inch.

PENETRATION.

Observations taken on 30 piles chosen at random resulted as follows:

Average No. of blows to drive pile	from 0 to 10	ft.	16 blows.
" "	10 to 20	"	53 "
" "	20 to 30	"	102 "
" "	30 to 40	"	212 "
" "	40 to 45	"	199 "
" "	45 to 46$\frac{1}{6}$	"	106 "
Average total No. of blows,			688

Average penetration per 10 blows at	30	ft. deep	8$\frac{1}{2}$ inches.
" "	40	ft. "	4$\frac{1}{8}$ "
" "	45	ft. "	2$\frac{5}{8}$ "
" "	46$\frac{1}{6}$	ft. "	1$\frac{3}{4}$ "

This gives an average of about 6 blows per last inch of penetration.

Taking five blows as the least number per last inch, and using Trautwine's formula.

We find that the extreme load that one pile will sustain is 136.75 tons. This, without any allowance for the effect of the insistent load of four thousand five hundred pounds resting on the pile while it is driven, allows a factor of safety of about four and one half, as the piles will sustain about thirty tons each.

METHOD.

A space 144 feet square in the middle of the lot was excavated to a depth of 3$\frac{1}{2}$ feet below cut off grade, and the piles within this space, 1,340 in number, were driven by drivers running on cribbing on the bottom of the excavation and required no follower. The remainder of the lot was excavated in trenches or pits, and the drivers ran on top, the cribbing resting on the surface of the ground or the tops of piles partially driven. The piles were "followed" from the surface to the bottom of the excavations, and in some cases, where the excavations were not completed, the piles were followed several feet into the earth.

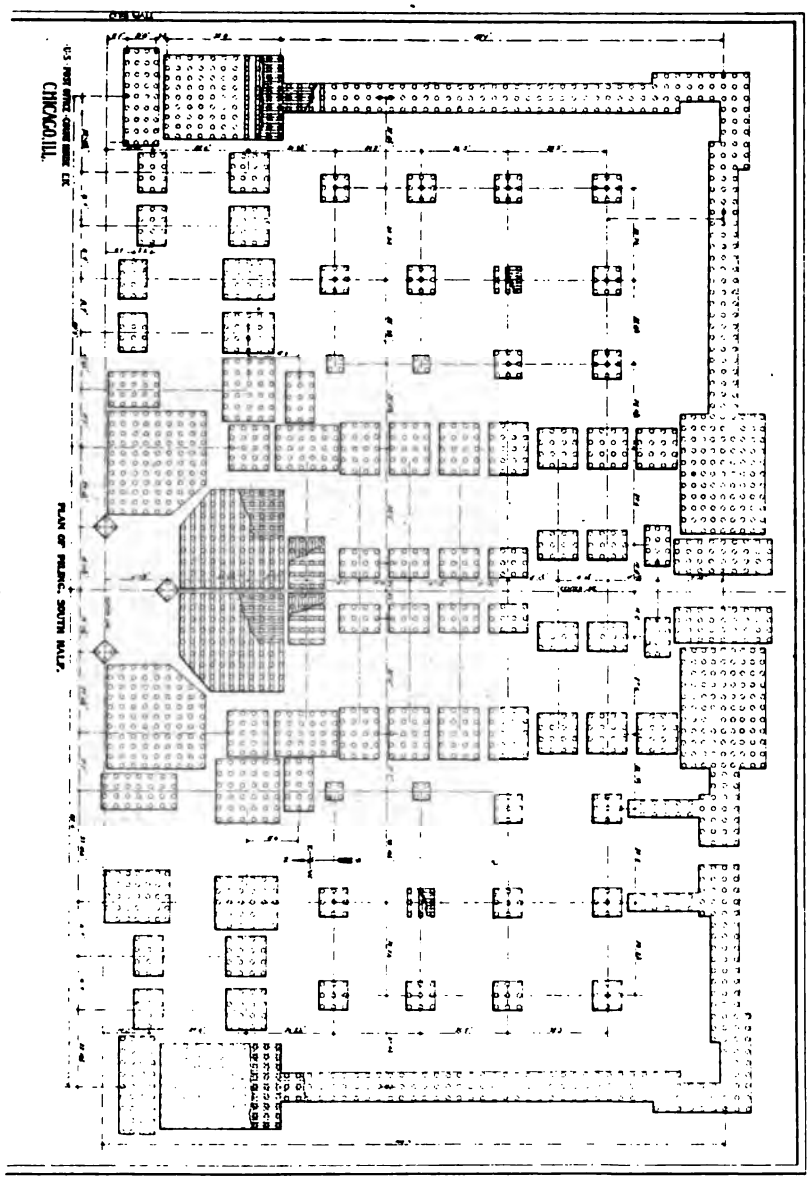


FIG. 2.

LENGTH OF PILES.

The length of piles after being cut off, varied from 42½ to 47 feet, and agreed well with the borings. The greatest variation was at the S. E. corner of lot, where the piles were 2½ feet shorter than the borings would indicate, and where the driving was extremely hard for the last few feet. In the center of the lot the piles were two feet longer than the borings indicated, but as none of these were made in that vicinity, this could not be called a variation.

DISPLACEMENT.

The displacement of material by the piles was found by adding the amount of material that would have to be removed to leave the lot at "finished grade," and the amount of all material (other than piles) put into the foundations, and subtracting the sum from the amount of material actually removed from the ground.

Amount to be removed to leave lot at finished grade	8242	cub yds.
Amount of material (other than piles) in foundations	19381	"
	27623	"
Amount of material actually removed	35230	"
Displacement of material by piles	7607	"

or 40 cu. ft. for each of 5087 piles corresponding very nearly with the volume of the pile.

This displacement took effect in the direction of the least resistance, generally raising the earth in the bottom of the trenches and pits from two to five feet.

Piles already driven were heaved or lifted by driving other piles in the immediate vicinity. This heaving amounted in some cases to 4 or 5 inches. Levels taken on test piles showed results as below; observations taken Sept. 21st, 1897. (See Fig. 3.)

Pile No.	Elevation when piles were driven as per plan.	Elevation when piles were all driven in piers.	Amount of heaving.
3	11.448	11.081	0.367 ft.
4	10.723	10.689	0.034 ft.
5	10.619	10.581	0.038 ft.
6	11.088	10.898	0.190 ft.
7	10.943	10.826	0.117 ft.
8	10.448	10.419	0.029 ft.

This shows a maximum heaving of 4⅜ in. in pile No. 3, but it is probable that it was raised some by the driving of the piles southeast of it before the levels were taken.

Piles which stood four rows or 12 feet back from the driving were heaved from ¼ in, to ½ in. and those 18 or 20 feet back were not affected perceptibly. These observations were taken where the driving was very heavy, that is, the whole area was filled with piles at distances of 3 ft. by 3 ft. 6 in. Where the piles were not so numerous, as in trenches containing two or three rows, the effect was not so great, as piles 6 or 8 feet back were not heaved.

As a test to determine whether the heaving made the piles any less secure

for a foundation, the hammer was placed on one which had been raised and it was struck 30 blows with the following result:

1st 20 blows 5 inches penetration or 4 blows per inch.

Last 10 blows 1¼ in. penetration or 8 blows per inch.

Taking ¼ in. as the penetration for last blow, Trautwine's formula gives an extreme load of 131.28 tons, which shows that the pile is practicalyl as safe as one requiring 5 blows for last inch.

Piles which were driven partially down, and allowed to stand for several days before following (as those on which the cribbing was placed for supporting driver) were found to be much harder to drive than those which were driven clear down at once. This may have been because the surrounding piles compacted the material below it, or because of the friction of the earth settling around it as it stood.

The follower used in driving the piles consisted of a 10 in. wrought iron pipe about 15 feet long, into which was driven a tight fitting cylinder of hard maple. On the lower end was bolted a cast iron hood, in the under side of which was a socket to fit over the head of the pile and on the upper side one to receive the 10 in. pipe. On the upper end of the follower was shrunk a 1x6

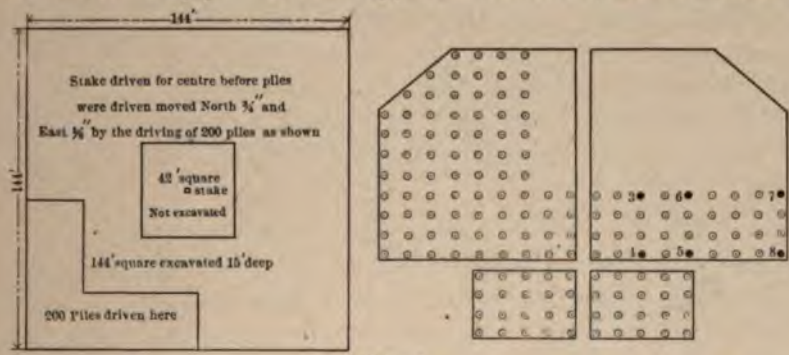


FIG. 3.

in. iron ring, forming a socket in which was placed a hard maple plug about 12 in. long. This plug was the only part that was injured by the force of the blow, and consequently the only part that had to be renewed.

Along one side of the follower was a one inch iron pipe, which screwed into a hole running down to the under side of the hood. This was originally intended to admit air under the follower to get rid of the "suction" when pulling the follower out, but it was afterward connected to the boiler by means of a rubber hose, and the steam pressure used to assist in pulling the follower.

Plate—Another improvement in the pile driver was a steel plate 1½ inches thick and of sufficient diameter to fit in the hammer. This was placed on top of the pile, and was a great protection against splitting or brooming. Later on a new casting was made for the lower part of the hammer and this contained a slotted "recess" to hold the steel plate in the proper position, so that it was not necessary to handle it when moving from pile to pile.

Timber Chapping—After the piles were sawed off at the proper grade, white oak caps 14x14 in. were placed on top of top of them, crosswise of the trenches, and bolted to the piles by means of one inch wrought iron driftbolts, 24 inches long, one in each end of every timber. On top of these caps was placed a solid

platform of 12 in.x12 in. white oak timbers, the outside timbers of each platform being bolted to each cap timber by a drift bolt 20 inches long. The caps and platform timbers were all planed and sized to the dimensions given, to insure good bearings.

Concrete—On top of the platforms was placed a layer of concrete 3 feet thick, composed of one part Portland cement, two parts sand and five parts crushed stone.

The cement was required to show a tensile strength of 250 pounds in 7 days, mixed in a proportion of 1 cement to 2 sand. The concrete was all mixed by hand and the amount put in varied from two to three cubic yards per man per day of 10 hours, depending on the distance of wheeling material and concrete.

The cement and sand were first mixed dry, then water was added, and the stone was spread on top. The whole mass was then turned by shovels two or three times, and then shoveled into wheelbarrows or directly into the piers, where it was spread in layers about 6 inches thick, and thoroughly tamped.

Test holes about two feet square and two feet deep were sunk in two piers to determine quality of concrete. The concrete was taken out in chunks as far as possible, and the sides of one hole were brushed with a steel brush, and the other was washed with water from a hose. No voids were found, and the concrete was very hard, considering the short time it had been in place. There are 5,122 cubic yards of concrete. The cement used at the beginning of the work was Alpha, but later it became impossible to obtain the Alpha and Atlas was substituted.

Masonry—The masonry was built of Joliet and Lemont limestone.

The stone used varied in thickness from 10 inches to 30 inches and was dressed so as to make the joints not more than one inch. The outsides of the piers and walls were left rough and in some cases extended several inches beyond the neat size of the piers.

The mortar used consisted of one part cement to two parts sand, the cement requiring the same test as for concrete.

The stone was all laid by derricks. In the central part was a system of four boom derricks, located on the axes of the building, 85 feet in each direction from the center. These derricks had 80 masts and 75 ft. booms, and laid all the stone for foundations for dome and the greater part of the lines of piers running out under the walls of the main wings of the building. The corners and outside walls laid by four traveling derricks. Each derrick is supported on a turntable, revolving on a circular track of railroal iron. This track is on a platform, which is moved on rollers in the same manner as a piledriver. The engine is placed on the rear end, and balances the weight handled. This derrick will lift several tons, and is much more convenient than a guy derrick as it can be moved so readily from place to place. On account of delay caused by lack of material, it was difficult to estimate the amount of work that one derrick can do, but from 1,000 to 1,500 cubic feet is a fair day's work (8 hours) when the material is on hand ready to put in without any dressing. This requires a force of 4 masons, 4 laborers, 2 hookers, 1 engineer and 1 fireman.

The total quantities of material handled and entering into the construction of the foundations and the unit prices were:

	Quantities.	Unit Prices.
Excavations, basement.....	22,267 cu. yds.	$0.33
Excavations, trenches.....	54,294 cu. yds.	0.34
Piles (50 feet long).....	5,087 piles.	11.70
Timber capping 796,352	feet B. M.	27.80
Concrete	5,122 cu. yds.	5.45
Dimension stone.....284,144	cu. feet.	0.24
Rubble Masonry.....	31,327 cu. feet.	0.16

The contract time for completion of the work was April 15th, 1898, and it was understood that all the dimension stone required could be so promptly furnished that the masonry could be completed before that date. In order that this might be done it was necessary that the stone should be nearly all quarried during the summer and early fall of 1897, so that it might be sufficiently seasoned to prevent cracking by freezing and thawing during the following winter. It turned out that the stone ran short during the winter, and a large portion of it had to be quarried during the spring and summer of 1898. Strikes of the quarrymen occurred and the delivery of the stone was so retarded that the masonry could not be completed until September 26, 1898.

The character and capacity of the plant provided by the contractors for doing the work were such as to make its accomplishment easy and certain within contract time, if the materials had been delivered as contemplated, and the plant handled with skill and energy. The rapidity with which pile foundations can be put in under the circumstances which exist in Chicago, is a strong consideration in their favor in this city of hurry and push.

A careful estimte of the cost of the foundations if wells, filled with concrete, had been employed showed that it would have exceeded the contract price of the pile foundations by at least one hundred thousand dollars, and the excess of the estimte for the steel and concrete platform plan over the actual cost of the pile foundations would have been at least twenty-five thousand dollars.

None of the circumstances pointing to the use of either of the other two plans existed in this case, and there was, therefore, no room for doubt as to which plan should be adopted.

The reasoning herein presented has been full confirmed by all the facts developed during the progress of the work, and we feel that the pride and confidence that we have in this typical example of pile foundations for this locality are fully justified.

William Sooy Smith, C. E.,
Engineer in Charge of Foundation Work.

THE EVOLUTION OF STRUCTURA L DESIGN.*

IT IS the purpose of this paper to show how the development of Structural Design is due rather to varying and improved conditions governing cost and availability of material than to more perfect knowledge of the theories of mechanical statics. The writer does not intend to treat of ornamental design, with classification and details of the various forms and mouldings adopted under historic regimes, but will endeavor

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to restrict himself almost entirely to that part of design (especially frame-design) which by the use of the most effective and economical materials overcomes such natural forces as those exerted by dead and live loads, wind pressure and the effect of heat and cold, and he feels that it is not unsuitable for him to take up such a subject, on account of his double duties in both contracting and engineering; in combining which the truth of his initial statement is being frequently evidenced. The principal authorities consulted have been Ferguson's History of Architecture, Cooper's American Railroad Bridges and Weale's book on Tubular Bridges.

Going back to the earliest civilizations, we find that their roofs and arches show most plainly the action of the above-stated principle. In Egypt the most primitive structures had each opening spanned by a single stone, in many cases of great size.

Their temples consequently show the ruins of many interior supports; but mystery and gloom being so large a part of their religion, the multieude of heavy stone columns covered with hieroglyphics was congenial rather than otherwise. There is no evidence that their old temples were roofed in any other way than by single stones, although structures of later times show signs of arched coverings.

The Greeks and Romans often used the same method, and have left one example, the Mausoleum of Theodoric at Ravenna, which has a domed roof formed of a single stone nearly 35 feet in diameter,—a size which makes us think meanly of this century's masonry. The Greeks also used wooden beams as roof supports, which have almost entirely perished, but their construction was luckily copied in the stone friezes which remain to-day, wherein the ends of the rafters with all the necessary cleats and nails are reproduced in the carved masonry.

Their temples seem to indicate a very ingenious mode of lighting the interior without impairing the harmony of the exterior, which might teach a lesson to some of the builders of our older office blocks.

The inside of a Greek temple contained nothing but a statue of the patron god, upon which it was very desirable to cast a good light, the roof being arranged as in Fig. 1.

To the Romans we owe the elaboration of the arch,—i. e., the radiating arch,—for there was among the Hindus a very different kind of arch in use. Not very many of the oldest Roman buildings were covered in this way, but it was used extensively in tombs, drains and treasuries. It is easy to see how the arch came to take the place of single huge stones, such as were employed by the Egyptians. The only way in which such heavy pieces could be handled, without the use of machinery, was by working hundreds of people, who had to spend their lives in lifting. Egypt had thousands of such able-bodied and ambitionless slaves, while Rome in the earliest times owned very few slaves, and later they were so weak and effeminate that such tasks would have been impossible. The rocks themselves also were more readily used in smaller pieces. The evolution of the arch was like this: First, a single stone beam was used to span an opening, then, when the length became too great, two stones were inclined to-

FIG 1.

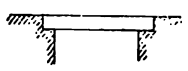


FIG. 2.

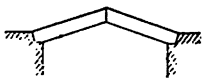
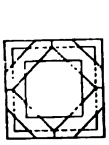


FIG. 3.

FIG. 4.

FIG. 6.

FIG. 5.



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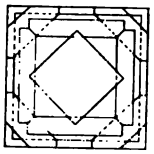

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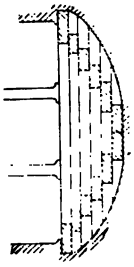

FIG. 9.

FIG. 11.

FIG. 12.

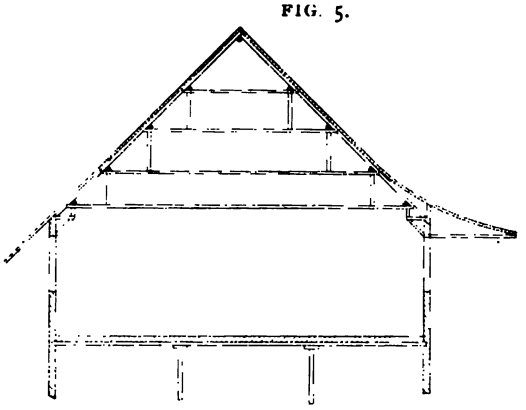

FIG. 10.

FIG. 13.

FIG. 14.

FIG. 15.

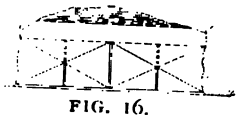

FIG. 16.

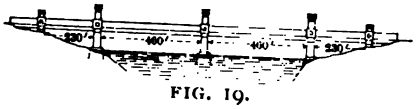

FIG. 19.

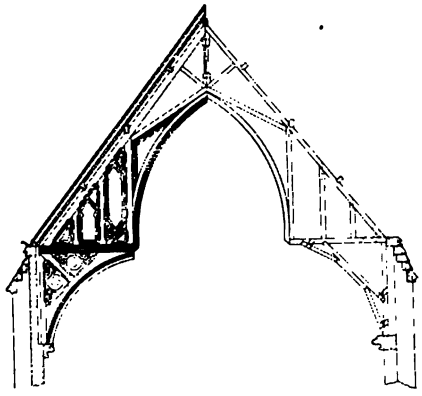

FIG. 17.

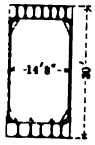

FIG. 20.

FIG. 18.

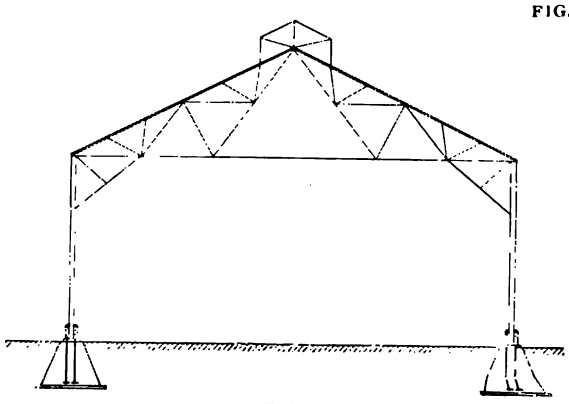

FIG. 21.

gether, and soon a third was added, which we now call the Keystone, and with more skilled masonry work the number of stones was increased as shown in our own arches. (See Figs. 2-5.)

In India there are arched roofs built on an entirely different principle. Such examples as have just been described cause an outward thrust at the spring, more or less great according to the span and versed sine, which has to be overcome by the dead weight on each side. The joints all pointing to a common center, they are called radiating arches

This outward thrust was altogether distasteful to the Hindus (they have a proverb that "an arch never sleeps"), and so they built what is called the horizontal arch, which in section looks like a number of cantilever brackets, but is not so

They first employed the simplest method of covering a space with a single stone, thus: but for the ordinary use that practically limited their openings to about 4 feet square; and so they filled the corners with four triangular stones, resting the single stone upon them; and so covering a space about 6 feet square without using a stone bigger across than 4 feet. (Fig. 6.)

With an increasing number of stones, extra supports were found necessary round the sides, but leaving a clear space in the center of sometimes 40 feet square, which would look like Figs. 8 and 9.

Such an arrangement will of course bring quite a bending moment on the lower course of stone, but there will be outward thrust.

The Chinese have to use an entirely different material, which abounds in that country,—viz., a species of small pine which has the peculiarity of being soft and spongy inside, while the outer rims of wood just under the bark retain their strength and hardness. It is thus practically a wooden cylinder, good for direct compression and bending if left whole; but if sawed into planks or "sticks" as we say, to form any kind of a trussed framing, would fall to pieces; like a built section of plates and angles with the rivets left out. Therefore they make their upright supports of these small trunks, bracing them along the sides of the building with "sway knee-braces" of the same material, only smaller growth, and arrange their framing by means of a series of horizontal beams, each having its ends supported on that below by a short vertical strut of a sounder but rare kind of wood. (Fig. 10.)

It is interesting by the way to notice how the requirements of the Chinese climate are met by the peculiar outline of their roofs, which are concave. This is not copied from the tents of the wandering Tartars, which in fact were always domical, but they are so shaped for two reasons. During their rainy season such large quantities of water have to be carried off that a low pitch would cause leaks, and therefore the part over the house must be steep. At another season of the year it is absolutely necessary that some shade be provided over the windows from the fierce, glaring sunshine. Now, if the roof were to run out over the windows far enough to furnish ample shade from the sun, it would come down so low as to also keep out the light and air (see dotted line at left of Fig. 10), and, consequently, John Chinaman curves up his eaves outside the walls, where a perfectly water-tight covering is not so necessary, thus forming the peculiar shaped roof with which we are familiar.

There is a method of roofing which should be mentioned before going into the growth of trussed structures,—viz., groining, which is essentially a combination of arches, meeting together, the lines of greatest pressure being marked by ribs, which in later examples were often highly ornamented. Chapter houses of the old world cathedrals were generally covered in this way.

With the advancement of civilization there was a demand for more buildings, which were required to be erected in less time than had previously been the case, and a change from the old arch practice was necessary. To meet the new circumstances, the trussed roof was evolved, like the arch, from very simple elements. The commonest way of spanning openings up to about 12 feet had been by means of a single wooden beam. Wider spans suggested two beams sloping together; but instead of resisting the outward thrust so caused by means of buttresses outside the building, a horizontal tie-beam was thrown across, holding the two feet of the rafters together. (Fig. 12.)

When still greater spans were required the middle of each rafter was supported by means of struts, sloping in towards the bottom of a vertical post which ran from the apex to the middle of the tie-beam, so forming the well-known king-post truss. (Fig. 11.)

Further developments brought forth the queen-post truss, and others with more members to suit the span.

The larger use of timber framing followed the introduction of saw-mills. The earliest methods of cutting timber had been by wedge-splitting, which although it injured the fiber less was very slow and expensive. The Greeks invented the handsaw, modeled either on a serpent's tongue or the backbone of a fish, and there is a literary allusion in fifth century writings that suggests crude sawmills then; but not until the fifteenth century do we find reliable indications of wind saw-mills in Germany; and in England early in the seventeenth century, accompanied, as usual with all mechanical improvements, by the greatest opposition on the part of the workmen. Simultaneously we find the elaborately framed roofs of the perpendicular period.

There is a peculiar sort of roof-truss common in many old churches which made use of the hammer-beam. Essentially this truss is framed by merely putting a pair of brackets in the walls and resting the truss on their ends. (Fig. 17.)

These were profusely carved and ornamented. There is a good example of the hammer-beam roof in the west wing of D. H. Holmes' store on Canal street in New Orleans.

But all these older forms of trusses were made almost entirely of timber; with new methods of producing iron, and consequent diminution in its price, we see many changes. Keeping the same arrangement of members, those in tension were gradually replaced with iron; first the king-post (called the king-bolt when made of iron), and later the tie-beam, gave way to the iron horizontal tie-rod. It is curious to notice how slowly the carpenters of those days kept to the memory of old timber trusses, and what abortions were often the result of its union with iron. Here is a roof-truss stretching across a hundred-foot span drill hall, in which we see the king-post at the top, lower down the queen-post, and some iron rods thrown in at the bottom. (Fig. 13.)

Perhaps the best type of this combination truss is the Princess, in which it will be noticed that the ties, which are of iron, have a minimum length, an arrangement due to a desire to use as little as possible of a comparatively expensive material. (Fig. 14.)

The well-known Howe truss exhibits similar economy.

When the manufacture of cast iron became more reliable and better understood the compression members or struts were made thereof; but as one of its properties is a great loss of strength when in long unbraced lengths, another change in the arrangement of members was required, which resulted in various forms of the Fink truss, which has short struts and long ties. (Fig. 15.)

This truss can be well used for bridge spans by turning down, and they tell how its introducer, an army officer in the Civil War, made a novel use of its properties to fool the enemy, who had been accustomed to bridges with two parallel chords. The Fink truss can be quickly built in an emergency, and when it was necessary to throw a bridge across water he used this type, but added superfluous members in the shape of a dummy bottom chord. (Fig. 16.)

The opposing forces, wishing to destroy the bridge, and supposing it to depend on the bottom chords, shot them away, when of course the essential members remaining intact, she stood solid, presumably to their great amazement.

This Fink truss is now well adapted to shipment, being riveted up at the shops in two (or for large spans, four) sections, which can be easily suited to railroad car capacities, and assembled in the field; whereas the older forms for larger trusses were too high for transportation.

The struts in Fink trusses generally consisted of hollow cast iron tubes, attaching to special fittings at each end, and often ornamented at the middle with a shell casting. Such a connection is all right for a member always in compression; but when it became desirable to replace the building walls also with iron, wind strains often induced tension in some of these struts, for which the cast iron forms used were altogether unsuited. Then came the invention and improvement of new processes for making rolled sections, careful tests of properties and new tools, which combined to give sections strong both in compression and tension, of which the best modern roof frames are constructed. As a further example of the dependence upon shop work for our best practice in construction, it may be noted that until quite recently it was usual to make some allowance in the length of members, to be adjusted during erection with wedges, etc., a device which would throw out any careful and exact calculations.

The way in which iron and steel have entered into our roof construction is capable of much further illustration, having many points in common with modern bridge construction, as compared with older methods. In the first twenty pages of Theodore Cooper's book on American Railroad Bridges he shows how wooden bridges were gradually improved with, and then replaced by, iron in its various forms, and there may be found many examples of this reconstruction period, which will also apply to large span roofs. From Mr. Cooper's very quaint list of old-time structures, and such other sources as have been available, the following may be of interest:

The first iron bridge in England was built about 150 years ago near Coalbrookdale over the Severn. It is a 100-foot span arch of cast iron. The 250-foot

cast iron arch spans of the Southwark Bridge, London, built about 1810, are still in use. Cast iron was also used up to the middle of this century for railroad bridges, up to 40-foot spans, a girder section of this kind being used, but its liability to crack under impact and to fail in the tension flanges rendered these unsatisfactory. (Fig. 18.) The first wrought iron to be rolled was by Cort, of Southampton, England, under patents of 1783, and during the first half of this century such wrought (or "malleable," as it was called) iron as was used, either for reinforcing tension flanges of cast iron, or later alone, had to be punched, beveled, bent, etc., either by hand or by means of a lever-fly, which machine consisted of a large weight acting at the end of a lever to work the metal, something like a garrote. But in 1846-9 the hydrostatic press and steam riveter were introduced, whereby all shop work could be performed more economically and accurately, and access to these tools caused Robert Stephenson, William Fairbairn and Eaton Hodgkinson to decide on the use of wrought iron for the famous Britannia Bridge across Menai Straits. This structure has never been surpassed in many respects, and a few data may be of interest. It is called a tubular bridge, and is in theory constructed like an immense box girder, the train passing through the box. The top and bottom flanges consist of cells built up of plates, angles and tees, each cell being large enough for a workman to get inside to rivet up. In section this girder looks like Fig. 20.

Each tube is 472 feet long, two being placed side by side for the two railroad tracks, and the bridge consists of four spans resting on five masonry piers, 100 feet above water line. Each tube weighed over 1,600 tons, and on account of the constant passage of vessels had to be constructed on trestling 100 feet high, on pontoons, and floated into place complete, the exactly correct elevation being secured by pumping water in or out of the pontoons. The first tube took two hours to get into place from the time it left its moorings. And all this in 1850 and over open sea water! (Fig. 19.)

But even these methods of working the material were comparatively crude and expensive (wrought iron being then worth nine cents per pound), and prevented its general use; and in the popularizing of iron for structural purposes we have to look to three causes, two of them entirely American,—viz., Eads' wonderful bridge at St. Louis, and the development of pneumatic tools. The other, Bessemer's process of converting pig iron directly into steel, is an English invention, but its fullest developments have occurred in this country.

Taking up the Eads' bridge first, 1868-74, one must note that the mills then very few of what are now called "standard sections," each manufacturer turning out such shapes as appeared right in his own eyes. A glance at the catalogues of ten years ago shows that even then much of this isolation had not disappeared. It was necessary then for Mr. Eads not only to develop his general design, proportion the sizes of members and provide for his revolutionizing method of erection by the cantilever process, but, being unable to find the sections required on the market, he had also to design them, and indeed very largely the machinery for rolling them. After much discouragement he succeeded, and immediately there appeared the beginnings of that tendency to "standardize" which in its fullest developments enables one to telegraph to the shops an order for quite complicated structures in half a dozen lines, and know exactly the detail dimensions and arrangement of the material that will be shipped.

The next step was the Bessemer converter, which has enabled structural steel to be marketed at a price one-third of that obtaining for iron twenty years ago, and this for a material stronger by 25 per cent. Until quite recently Bessemer steel has been used more for buildings than for bridges, for a reason to be mentioned later; but its use in conjunction with hollow tile has made possible the twenty-six story buildings of the present time, combining cheapness, lightness and strength with the more convenient arrangement of interiors thereby made possible. Having then this material within reach, our engineers have developed its use along new lines to an unprecedented extent. The concentration of the loads in a building on the columns only has caused new departures in the way of foundations for soft localities, and has enabled the loftiest structures to be built right up against old and small ones with minimum party wall damage and litigation.

But for a long time Bessemer steel has been debarred from railroad and other important bridges, etc., on account of the supposedly injurious effects of punching in disturbing the metal surrounding a hole. Engineers have specified that if used it should be drilled instead of punched, or reamed out, which has made its cost almost prohibitory. Just what the extent of this injury is has been a debated question; but the tool manufacturers have happily taken it out of the domain of the practical questions by the series of pneumatic tools that have recently been put on the market, and by whose use holes can be sub-punched and reamed many at a time at a very low cost. These tools are also successfully used for shop and field riveting, beveling, caulking and many other purposes, insuring the highest class of workmanship. The effect of these improvements has been not only to give us better structures, but but has caused a marked change in the practice of designing bridge spans. A few years ago a 100-foot span was always built on the pin-connected type. Now, such a span is preferably riveted plate girders or lattice trusses, on account of rigidity; and with the larger use of the latter, theoretical points have arisen and been largely settled concerning the action of stresses in same and proper connections.

It may be of interest here to briefly compare American with what has been European (especially English) practice in bridge construction. In this country the entire working of the material is done at the shops, from details and templates very accurately prepared; and it often happens that half the members in a structure come from one place, and the balance 1,000 miles away, and are never brought together until assembled in place at the site. So happily has this work been systematized, and so carefully are the working drawings checked and followed, that discrepancies need not be feared. In English shops the practice has been very largely to cut and fit, using fewer drawings and placing more dependence on the workmen. During the construction of the Britannia Bridge, about 1850, and the Forth Bridge, as late as 1890, large shops were temporarily erected at the sites, where the various pieces were measured for and then worked piecemeal. In the case of a large bridge over the Indus in Hindustan, the London builder even went so far, in his fear of misfits, as to erect the entire structure in his yards before shipment, and then take down before sending away. An enormous expense! This comparison may throw a little light on the causes of America's recent success in competing for this class of work; for we secured the

large Hawkesberry Bridge, Australia, against the world (the metal being manufactured and completely worked ready for erection in Pennsylvania), and we have lately been low bidders on several structures in Europe itself.

As an example of the effect of local conditions in bringing out well-known but little-used theory, the writer may briefly refer to a point in his own New Orleans practice, in connection with light steel buildings, consisting of bents composed of two columns supporting clear span trusses, with purlins and girts between, and lateral bracing. (Fig. 21.)

Such a bent is figured to resist the force of side winds by the action of the knee-braces, whose kick is withstood by the moment of resistance of the columns, and whose trusses are transmitted through the truss-members to the opposite side. The columns in other localities are customarily provided with small steel shoe plates, and short anchor bolts, say 15 inches long, and the lower end considered hinged. Now it is well known that a beam fixed at one end is much stiffer than if merely supported there; and a short consideration of our local conditions showed the possibility of this increased stability and economy. All our ground here is soft and damp, and will carry only one-fourth the load that sounder soils elsewhere do. This means that the foundations for columns have to be unusually large and deep. Why could not these masses of masonry be utilized for "fixing" the feet of columns thereby producing a point of contraflexure that would reduce the leverage of the wind-kick, and enable the sections of columns, knees and truss-members to be made lighter, and with increased stability?

The large anchor bolts (av. 2 sec. upset x 7.0 sec.) and stiffener angles do not weigh as much as the saving in framing above, and the cast base-plates required for this construction are just what is needed to prevent the dampness rising to attack and rust the more susceptible steel above. This fixing the column bases also facilitates erection, and tends to prevent accidents during raising.

In conclusion attention should be called to the fact that since our earliest history there has been but little modification of the theories that govern a frame structure; and necessarily so, for they are simple and unchangeable. I count but three, and two of them were state by Euclid and Archimedes over 2,000 years ago so clearly that we still use their writings as text-books in our schools. These are: 1. The Triangle of Forces. 2. The Lever. 3. Ut Tensio Sic Vis.

If one can clearly follow out the workings of the first two, he can compute the stresses induced in the most complicated framing ever designed. A thorough understanding of the last is all that is necessary to properly proportion the various members to safely resist those stresses. The evolution of structural design has come about not so much from a deep searching into the abstruse mysteries of pure mathematics, as by the continuous and intelligent endeavor to meet the requirements of the thing in hand in countries widely remote, under changing conditions, and with materials of varying capacities.

We have seen how structures of such different types have been used, and why: the single huge stones in Egypt, because their shop or rather their field practice was to handle great masses; the stair-truss in China, due to the peculiarities of the timber there; the horizontal arch among the Hindus, because the radiating arch "never sleeps," and that would not suit a Hindu; th egroined vault and heavily timpered roofs of Gothic churh builders, those being the forms which

would most readily adapt themselves to the interior decorative effects of which they were so fond, and which could then be cheaply sawed; and finally the steel roofs and bridges of our own time, which are the outcome of the experience and labor of our forefathers, the inventive genius of our ironmasters and the increased capabilities of our mechanical tools, combined with the demand for such mammoth structures as we see going up all around us.

THE WISSAHICKON ARCH, PHILADELPHIA.*

The bridge in Fairmount Park, Philadelphia, over Wissahickon Creek is a very handsome structure, having been built from the design of General Russell Thayer, chief engineer of The Fairmount Park Commsision, at a cost of $27,743, including the removal of the old bridge,

The arch is on a skew of 69 degrees 26 minutes, which is taken up by arch rings, four feet wide each. The span of each ring is 106 feet 6 inches, the clear span of the arch 105 feet and the rise 11 feet. The spring of the arch is about six feet above the surface, at which point the arch ring has a depth of 4 feet 6 inches, while the depth of keystone is 3 feet.

The roadway 25 feet in width and the two sidewalks of 5 feet width each are paved with asphalt.

The stone of which the arch was built was quarried about one half mile from the site and is a dark colored gneiss. The stone work is quarry faced ashlar, with a one inch chisel draft at each joint. This making a 2 inch draft at each joint. This gives a very fine appearance to the work.

The shallow depth at the center is relieved by the solid parapet, which has dressed stone coping, post and caps, and which is supported on a coping, carried by well proportioned modillions.

The symmetry of the design is unfortunately spoiled by the character of the bank at the left end, which is the more to be regretted as the right abutment is a most suitable and elegant arrangement. "F"

THE SCHENLEY PARK ARCH.

The stone arch bridge recently completed in Schenley Park at Pittsburg is known as the Bellefield Bridge. It was designed by H.B. Rust, Engineer of Schenley Park and is one of the most elaborate stone bridges in this country.

It has a span of 136 feet 7 inches and a width across the soffit of 82 feet. The roadway is 60 feet in width, while the 2 sidewalks have a width of 10 feet each. The depth of Keystone is four feet.

The arch is a very bold one, and the general design leaves little to be desired, while the balustrade is a most elegant piece of work. It is however unfortunate that the abutments and the spandrels were decorated with the paneling, as the apparent size of the arch is very much reduced by these details which have been characterized by Fergusson in a criticism of the Chester bridge as a mistaken application.—"by exaggerating his details, the bridge has been dwarfed in exactly the same manner as the basilica." * * "It is far better that we should be content with plain, honest, solid but useful erections, than that our buildings should be adorned on the mistaken principles which have hitherto been supposed to constitute the art of Architecture." "F."

*Subject of Frontispiece.

THE SCHENLEY PARK ARCH, PITTSBURG, PA.

NOTES ON THE GRANITES OF NEW ENGLAND.*

DURING the summer of 1897 the writer had opportunity to visit some, though for lack of time not all, of the leading granite-producing regions of New England. These notes are intended to give some of the results of observations made. In the order of the value of the granite produced, the New England States rank as follows: Massachusetts, Maine, Vermont, New Hampshire, Rhode Island, Connecticut. These States produce annually from 65 to 70 per cent of the total output of the United States. The products of some of these quarry regions have national reputation and are shipped to all parts of the United States.

The leading position of the New England States in respect to granite production is due to a combination of circumstances and facts, among which may be mentioned the age of this region of the country, the fact that granite is found in great variety and abundance, and finally the fact that many of the quarries are favorably located for cheap transportation of the products by water to the various points of consumption. Such advantages of location on the water are the possession of quarries in Maine, some in Massachusetts, Connecticut, and elsewhere, but they are of less importance now than formerly. At present much of the most valuable monumental granite is, from necessity or choice, shipped from the points of production by rail.

MASSACHUSETTS.

This State has always been the leader in magnitude of output. The principal producing localities are Cape Ann (including Rockport, Pigeon Cove, Lanesville, and Bay View) and Quincy (including West Quincy). These two regions produced in value somewhat more than half the total output of the State, and are about equally productive; but the uses to which the output is devoted are radically different, in that the Quincy granite is strictly a monumental stone, of national reputation, while Cape Ann granite is primarily a building stone, which can be rapidly quarried and in any desired size of blocks. Other important centers of production in the State are Milford, Monson, Fitchburg, and New Bedford. In addition to these are numerous scattered localities at which valuable stone is produced, but in smaller amounts.

Quincy.—So well is Quincy known as a granite region that it almost seems needless to say anything more. Mineralogy, the stone consists chiefly of quartz, hornblende, and feldspar. There is a high percentage of quartz, and to this is largely due the extreme hardness of the stone. The distinguishing features of Quincy granite, which have given it the high reputation it bears, are its hardness, the durability of the high polish which may be developed, and the contrast between the polished and the hammered surface. This latter feature is more pronounced in the so-called dark Quincy granite than in the light, and for this reason the former commands a higher price.

According to Gillmore the crushing strength of Quincy granite is 17,750

*From the last report of Prof. Wm. C. Day, to the U. S. Geological Survey.

pounds to the square inch; its specific gravity is 2,669. The following analysis was made by Mr. E. R. Angell, chemist of New Hampshire State Board of Health:

Analysis of Quincy granite.

	Per cent.
Silica, SiO_2	75.14
Alumina, Al_2O_3	15.57
Ferrous oxide, FeO	2.49
Lime, CaO	1.85
Potash, K_2O	.54
Soda, Na_2O	4.41
Total	100.00

The qualities of granite are such as to render it so desirable for monumental work that it is inexpedient to devote the best of it to an any other use, and very little determined effort is made by producers to extend its application to building purposes, for which it is also admirably adapted.

Granite for monumental use must be carefully selected, and there is consequently considerable waste of material, which would serve excellently for building, but the producers seem to make but little effort to dispose of stone for this purpose, although not a little finds it way into retaining walls and bridges erected by railway corporations along their lines. Occasionally, also, the granite is used in large and pretentious buildings, but not to the extent to which the qualities of the stone woul seem to justify.

Many of the producers at Quincy have been engaged in quarrying for monumental work only for many years, and considerable conservatism as to business policy is the not unnatural result.

Quarrying for monumental stock and for building material are two quite different operations, and if one of these is emphasized at all the other is apt to receive but little, if any, attention. To operate a quarry producing both kinds of stock at the same time, and withal to develop the quarry with due regard to future operations, is a difficult matter, and requires, moreover, a liberal working capital. This is, in many cases, lacking. There is at Quincy a strong temptation to quarry for to-day only. A fine piece of monumental stone is visible in a certain part of the quarry; it can be sold for cash as soon as taken out; it is therefore removed as quickly as possible, and in many cases without such thought for the morrow as will make future operations economical.

Refuse stone is frequently freely and generously given to paving-block cutters, who cut it into paving blocks and sell them on their own account. Knots, streaks, and "mud holes" must be carefully avoided in a conscientious selection of stock for monumental work; but these defects, except the third, would be of but little moment in stone devoted to a wide range of building purposes.

In former years the production of paving blocks was actively carried on, but as many quarrymen put it, the paving-block industry has "gone to the dogs," owing to the competition of other kinds of paving material. While paving blocks are still being made to a slight extent there is very little profit in the business, the maker of the block being able to realize little more than $1 per day for what is very hard labor. Paving cutters in the past few years, owing to difficulty in securing other kinds of work, have been obliged to cut blocks for small return or do nothing at all.

The methods of quarrying at Quincy are to blast with lewis holes and then cut into blocks by plug and feather. Sometimes, but not often, channeling is resorted to, but the hardness of the stone is such as to make this very expensive. In channeling, holes are drilled with a steam drill, an inch apart, and then the partitions between the holes are broken down with the channel bar.

Quincy granite is at present used chiefly in the Eastern and Middle States, less being sold in the West than formerly. This is accounted for in two ways; in the first place but few, if any, Quincy salesmen are sent to the West, and Eastern granites that are more easily quarried, and hence cheaper, are largely monopolizing western trade.

Cape Ann.—As already stated, this region includes Rockport and vicinity, Pigeon Cove, Bayview, and Lanesville.

Methods of quarrying and handling stone here offer a strong contrast to the conditions at Quincy, for the reason that monumental work is ignored at Cape Ann, and building stone is the product of sought. The stone is decidedly less valuable per cubic foot, and the amounts disposed of and the methods of working must compensate for this. Everything must be done on a large scale, and explosives must be used much more freely than would be permissible in quarries where smaller amounts of more valuable stone for monumental work are sought.

In every way Cape Ann seems to besuited to the production of building stone. In the first place, it is on the coast, and all the stone is shipped by water on ships that can come almost to the edge of the quarries. In the second place, the granite is enormously abundant and well adapted to heavy building work, in that it can be taken out in large blocks by expeditious methods of quarrying. In the third place, the construction of an extensive and much needed breakwater by the United States Government enables quarrymen to dispose of all grout at prices which help them to keep quarry property well cleaned up at less expense than is required at other less favorably located quarries.

The stone is a hornblende-biotite granite, medium to coarse in texture, grey in color, massive, and with both horizontal and vertical joints. It takes a good, durable polish, but, being a light-colored stone, the contrast between hammered and polished surfaces is not so strong as in some of the granites having an established reputation as monumental stones. Very little if any effort is made to push the stone as a monumental material, but the quarrymen seem as a rule to be content with the large possibilities of building, and quarries are equipped for operations on the scale necessary for extensive building contracts and the heaviest foundation work. A few years ago the production of paving blocks constituted an important item in the business of Cape Ann quarrymen, but, as at other localities, this is now suffering from depression and can no longer be regarded as cutting much of a figure in the total output of the quarries. The stone is well adapted for paving, and during the years when paving blocks were in active demand in large cities a product of considerable magnitude was turned out.

Another use to which considerable stone has been devoted is its employment in concrete in the construction of Government fortifications.

The methods of quarrying are in general similar to those of other regions, but are all carried out on a large scale. Powder is quite freely, but carefully used. Good railway facilities for transportation to the docks are provided.

A few large concerns do most of the business, which seems to be economically and judiciously conducted.

Some of the Cape Ann granite is iron stained, and on casual inspection might be taken for sap. However, it is not such,but a very tough, durable stone, which is well adapted for use in paving blocks or retaining walls. There is, of course, as at quarries, plenty of sap, but it is not identical with the iron-stained rock to which reference has just been made. Sap is not only stained from exposure, but shows signs of weakness and disintegration which render it unfit for construction work.

Cape Ann granite is quite free from knots or streaks, is very hard, spilts well occurs in enormous masses, and can be quarried in large blocks. Its special field is heavy work—massive foundations and bridges. The stone is so abundant that blasting may be resorted to freely in cases which at other localities would be treated by slower processes. Blasting may sometimes sacrifice material, but good stone is so abundant that, on the whole, blasting is more economical.

CONNECTICUT.

The most important granite quarries in Connecticut are on or near Long Island Sound.

Groton.—At Groton, just across the river from New London, are a few granite quarries producing only monumental stock. The stone is fine-grained, hard, and well adapted to this use. The valuable stock is in some of the quarries overlain by a large mass of rock, marked by numerous black dikes very much curved and folded and separated from the true granite by a sharp line of division. Under the sheet of granite is another thick mass of bastard rock. Quarrying is done on a small scale only, and is somewhat expensive owing to the large amount of stripping that has to be done. At Center Groton, five miles or more from Groton, is another isolated quarry capable of producing fine monumental stock in large quantity if capital were invested in sufficient amount. A long haul by wagon is necessary, and this is quite a drawback. Investment of more capital is imperative before anything considerable can be done at this point.

Waterford.—A large quarry at this point is operated by Messrs. Booth Brothers and Hurricane Isle Granite Co. The stone is fine-grained biotite granite, of grey color. Operations are quite extensive, both monumental and building stone being produced. The stone is of fine quality. The cutting, carving, and polishing plant is extensive, and at the time of the visit of the writer was being still further enlarged by the erection of a shed 220 feet long, intended to accommodate 100 men in the work of cutting and polishing.

Millstone.—Here is a large quarry, known as Henry Gardiner's quarry. This was originally opened in 1830. Even as far back as one hundred and fifty years ago millstones were quarried for use in the old-fashioned windmills, the ruins of which are in many cases still to be seennear Newport and elsewhere . When polished, the color of the stone is rather dark,and this shows a good contrast to the hammered surface, which is light in comparison. The stone is used chiefly for monumental work, although building stone is quarried.

Stony Creek.—At this place are a few quarries producing a highly feldspathic, coarse-grained, pink stone, well adapted to building purposes. Pink granite is at present quite popular among builders, and the attractive feature of this granite is its color.

Sachem Head.—At Sachem Head quarrying operations of very different char-

acter from those usually adopted are carried out on a large scale, for the single purpose of obtaining stone for breakwaters. A bluff 1,500 feet along has been exposed. From this the stone is removed by the most violent explosives, while in addition any and every way of dislodging stone cheaply is freely applied. Having been loosened out, regardless of size and shape, the stone is loaded on cars which carry it to scows and barges at the wharf a few hundred feet away. The plant for handlin and transporting stone is very complete, and altogether represents the investment of nearly $500,000. The firm operating here, Messrs Hughes Bros. & Bangs, makes a specialty of breakwater and canal work, and, in addition to extensive contracts for breakwaters, are also engaged in supplying lime stone at Buffalo for use in the Erie Canal. The workmen are all Italians.

Leete Island.—On this island a highly feldspathic pink gneiss is quarried for heavy construction and bridge work.

This stone has an excellent reputation for the purposes to which it is generally applied. It takes a good polish, and, from the wavy lines that were well shown in a polished slab which was exhibited, would look well in interior decoration in buildings.

Meriden.—At Meriden are quarries of trap rock, which is used only for railroad ballast and highway construction. The stone is fed into crushers and sold for ballast or macadam. Roads around Meriden, where the stone has been used, testify to the excellence of this stone for such use. Not only is the stone of remarkable strength and toughness, but as it slowly pulverizes the dust cements together at every wetting, making a surface of extreme smoothness. The stone seems to be the ideal road material. At one place the stone occurring on the mountain side is in small fragments, which are raked down down and transported to the crushers. This operation can hardly be called quarrying. From the solid masses in the quarry the rock is blasted by violent explosives,which are intended to shatter the stone as much as possible.

Ansonia.—Near this place are a few small quarries producing gneiss well adapted for street curbing, for which purpose much of the stone is used. The stone splits exceptionally well.

RHODE ISLAND.

This state has been distinguished as standing in first place for the value of monumental work produced. The most important quarries for monumental granite are at Westerly and Niantic. At some of the quarries only monumental stone is produced, but at others building stone is also sold in very large quantities.

Westerly and Niantic.—The monumental stock from these places is distinguished commercially as blue and white, the former being more valuable on account of the better contrast between polished and hammered surfaces. The stone is a biotite granite, of a crushing strength of 17,750 pounds to the square inch. Its value for monumental work is due to its fine grain, uniformity, and the fact that it may be safely carved to a fine edge, which it will hold without danger of chipping. In short, it is exceptionally well adapted to elaborate carving on blocks of great size. Many notable statues and monuments have been made of this stone, and its reputation has been established by years of experience.

Care in selecting stone has to be exercised, as streaks and knots occur. Some of these do not reveal themselves until polishing or carving brings them into view. As the producers are conscientious in letting only good stock leave the yards,

there is occasionally financial loss, due to the necessity for condemning a piece of work after considerable labor of an expensive kind has been done.

Some of the quarrymen are opposed to selling stock in the rough, but prefer to dispose of only finished products, as they can thus better protect the high reputation of the stone.

The largest block ever quarried here was 55 by 10 by 5 feet. Facilities for quarrying, cutting, polishing, and carving are of a high order at a number of the Westerly quarries. The latest improvements in all directions are tested promptly and, if found satisfactory, adopted. At one of the Westerly granite works considerable granite is sawed, with good results as to character of work and economy. Sawing granite is a comparatively new process, and it cannot be said to have yet come into anything like general use, but it is favorably regarded by a number who have tried it.

Since the financial depression began a few years ago, the use of Westerly granite for building purposes has increased. Some of the older quarries are now quite deep, and, although some very fine stone is taken out at considerable depth, the expense of quarrying is somewhat increased. Some of the producers, therefore, have found it necessary to extend their quarries laterally in order to obtain a larger volume of stone sufficient to accommodate building contracts as well as monumental work.

At no place in the United States is finer or more artistic work in carving and sculpture done than at Westerly. In monumental work Westerly granite has marked advantages over many others, but in building work it has no such advantages, and hence must be sold for building at prices which will allow it to compete with granites quarried for building only.

Granite is quarried at Centerdale, Pascoag, Narragansett, Newport, Coventry Center, Greenville, and a few other localities, but the amounts are small as compared with those produced at Westerly and Niantic.

Centerdale.—The stone produced at Centerdale is adapted to street work or rough building. The general tone of color is light, with a greenish tinge. The feldspar is faint pink in color. Quarrying operations are on a small scale.

Greenville.—At this point a hard, durable granite, suitable for building or street work, is produced. The stone contains a biotite here and there, giving a spotted appearance. The chief minerals are quartz and feldspar. The stone is used in Providence and Pawtucket for curbing and foundation work. It is also an excellent stone for engine beds. The stone looks well in rock-faced work. It is easily quarried, but has to be hauled 5 miles to railroad.

Pascoag.—The stone quarried at this place is a biotite gneiss, which splits very well. It is used for bridge work, curbing, and paving in Providence.

VERMONT.

Barre.—Over two thirds of the granite output of Vermont comes from quarries at or near Barre, and is known as Barre granite. Special interest, therefore, attaches to this region. The stone is distinguished commercially as "light, medium, and dark," these terms applying, of course, to the color. The dark Barre is the most valuable, on account of the stronger contrast between the polished and hammered surfaces, and also on account of superiority in other respects. The light granite occurs in rather regular sheets, while the dark granite presents a very different mode of occurrence, the sheets being more irregular,

so that a "dark" granite quarry looks more like a bowlder quarry than a sheet quarry. In quarrying the light granite considerable channeling is done. While such work is expensive, the rock is valuable and uniform enough to justify the extra pains. The dark granite is worked very differently from the light, in that more blasting is done, but without serious damage to the stone, particularly where the Knox system of blasting is used. In the light granite the frequent sticking of the drills gives evidence of considerable pressure in the granite. This is also borne out by microscopical examination, which proves the existence of strong pressure. Barre granite is remarkably free from flaws, such as white-horse and dark-horse knots, and streaks of all kinds. While blemishes are occasionally met, they are so infrequent that it is an easy matter to throw out such material without much loss.

The stone is easily and cheaply quarried as compared with that at some other places producing monumental stock.

The granite is what might be called "granite proper," consisting of quartz, orthoclase, microcline, biotite, and muscovite. The quarries are all on a hill or mountain, and the quarried stone is transported either by rail or by wagon to the town of Barre, a few miles distant. The granite industry at Barre has been built up within the past eighteen years, during which time progress has been steady and satisfactory. The features which have contributed markedly to this success are the favorable situation of the quarries for transportation to the railroad, the ease of quarrying, the uniformity of the granite, and its freedom from knots, streaks, etc. While granite of equally fine quality for mounumental work is produced at other places, the quarries at Barre yield a stock which is so uniform that the amount which has to be rejected and thrown on the dump is less. Lower prices for Barre stock are probably, therefore, just as remunerative to the quarryman as the higher prices which have to be charged in other places on account of a greater percentage of waste or the fact that the quarries have reached an inconvenient and expensive depth.

Facilities for cutting, carving, polishing, and finishing in every way are abundant and thoroughly up to date, and even in the hard times that have characterized the past few years the Barre producers have more than held their own.

New Hampshire.—The granite industry of New Hampshire is old and well established. The most important localities from the standpoint of value are Concord and West Concord, Milford, Suncook, and Fitzwilliam. Stone is also quarried at a number of other localities.

Concord and West Concord.—The quarries at Concord and West Concord are the most productive. Rattlesnake Hill, near Concord, is the source of most of the stone . The granite is used to a larger extent for building than for monumental purposes. For cut and hammered work in buildings there are few in any granites that surpass Concord stone.

The stone, being light in color, has to be carefully selected so as to be free from flaws. This, however, can quite easily be done, as there is a great abundance of entirely satisfactory stone.

The stone is a muscovite-biotite-granite, fine grained, and occurs in sheets. Quarrying is comparatively easy. Very little if any staining results from exposure in buildings.

THE ANCIENT MARBLE QUARRIES OF GREEK CIPOLLINO.

AFTER extensive search in Greece on the Island of Euboea, continued for several years over a large extent of country containing numerous quarries of inferior material now not worth working, a series of old quarries with beds of superior quality have at last been found on the Western coast, a little north of Carystus. The mule road from Calcis to Carystus goes through the center of the Island, passing through the villages of Stura and Kapsala, which lie in a valley. Between these villages and the sea on the western side, a range of mountains rises to an altitude of 2,000 feet, running steeply down to the sea. One mountain still goes by the ancient name Pyrgadi, referring to the fort or outlook-tower on the summit which commands an uninterrupted view south of the entire Gulf of Petali, and west the mainland of Attica with the mountain range of Pentelicus. Upon the sea face of this mountain are the ancient quarries extending from the summit to the base near the sea. The upper range of quarries is very extensive and of great interest; showing old methods of working; columns and architraves of immense size finished and partly worked lying in all directions. All these were wrought, engaged to the solid rock, and when roughly shaped were wedged off and finished; numerous examples of work in progress are still in situ. One quarry contains the old smithy, with a bevelled trough all furrowed and worn by the tempering of the tools; while another trough of large dimensions lies alongside, into which they were thrown to cool after being tempered. Another quarry of large extent contains a number of square-cut holes about 15 inches across, where the upright posts were inserted; these extend also down the old mountain-slide at intervals all the way, and were used by the aid of ropes for the lowering of extracted masses, some of which were 60 tons or more in weight. As the separate works were completed they were passed over a great paved platform, which is between the various quarries and the top of the slide, to the sea, for embarkation to Rome and elsewhere. This platform, no doubt, was that of the overseer, where the blocks were numbered and received the quarry and workmen's marks. On the upper part of the mountain-slide, where it crosses, a slight depression is made for some 70 feet, with transverse monoliths of spilt columns and architrave blocks, which were found fault in working, and as all the Roman monolith columns had to carry weight, no doubt the overseer condemned them at the outset. In the Bay the old harbor-mole for loading is visible at low water, and a barge-load of sunken columns is alongside. The Pyrgadi quarries no doubt belonged to and were exclusively worked for the State, while the lower quarries near the sea, named Duka, would appear to have been those of a private individual, and worked for lesser objects, such as pedestals and decoration, the quality being exceptionally good. The light parts are of a bluish and avanturine translucency with ivory whites, the darked banded parts being all shades of green and lakey greys, curled and bent about in all directions, producing, when cut into slabs and opened out, the most charming decorative panels or dadoes for wall-surfaces.

Carystium or Euboean marble, now called by the Italian name Cipollino, from its onion-like markings, was the first colored marble used in Rome. Some of the earliest examples are the ten columns to the portico of the Temple of Antoninus and Faustina in the Forum of Rome, thirty-eight feet long. Eight columns of similar size now remain in the old quarries, evidently worked at the same time, but never used. The quality of this marble and its appreciation by the ancients is proved by the immense quantity used; in Rome alone the number of columns of it, some of which are of immense size, are more than one-third of the entire various colored marble columns added together. The Roman always used monoliths of colored marble for their columns, never drums.

Roughly speaking, probably eighty per cent. of the wall and pier marble incrustation of St. Mark's, Venice, is of this Euboean Cipollino, the whole of which has been obtained by the sawing up lengthwise into slabs old columns opened out to produce continuous patterns, chevron or otherwise, as the veinings may happen to produce; this is readily proved by examining the open vertical joints which bevel inwards. The narrow outer slabs of the columns were afterwards used for strip linings of the semicircular alcoves; so nothing got wasted. These marbles have always been supposed by Mr. Ruskin and other writers to have been brought from demolished buildings of earlier date—and as regards capitals it may be correct; but when we consider that the Turks held and fortified Calcis and other places near the old quarries, and the residents to this day are not Greeks but Albanians, it is next to certain that the Turks knew of the quarries, and as only pieces remain of columns of movable size, while those of practically unmovable dimensions are left intact, it seems more than probable that the bulk of the supply was unused wrought material of late RomanByzantine date from the quarries.

The quarries are now being reworked, several shipments of beautiful quality having arrived in London. It is being used in a number of important works in London, and some large monolith columns are now being worked for the new Roman Catholic Cathedral of Westminster *W. Brindley, F. G. S.*

PREPARING A BLASTING CHARGE.

"Cut a piece of safety fuse to the right length and carefully insert the fresh-cut end in a blasting cap. See that the cap is free from any particle of sawdust before inserting the fuse. Press the fuse gently into the cap as far as it will go. Crimp the open end of the cap tightly around the fuse with a pair of cap-nippers, but under no condition disturb the fulminate or filling in the cap. Then open one end of the cartridge carefully, and with a sharpened lead pencil or pointed wooden stick, make a hole in the powder, insert the cap end of the fuse, being careful to see that at least one-fourth of an inch of the cap remains out of the powder. Then draw the paper closely about the fuse and tie it with a strong cord.

"Never allow smoking or fire of any description near the powder, nor leave any loose caps or fuse in the vicinity of the powder."—New York State Mining Law.

PRACTICAL STONE-CUTTING.—XIV.

THE plan given here in Fig. 1 is a correct copy of that given in Fig 1, of plate 12 and the vertical rise 9—D of Figs 2-4-5, equals that given in 9—D of Fig. 2 of plate 12, so that we have here the same problem to work out as that given in the preceding chapter, only here we are to make use of a different method to that already explained, for the projection of the several moulds and for the ascertaining of the size of rough stone.

We have at an earlier chapter stated "that the section plane selected of the Tangent System upon which the bed moulds may be developed, is not the most favorable one as regards the quantity of material required out of which the coping may be formed"; as a great quantity of material in the majority of problems is entirely wasted in order to have the joint surfaces at right angles with the working surfaces upon which the bed moulds may be applied.

In the construction of the models attention has been drawn to the central position of the section plane, that is, we have shown the position of the plane in question to be a central one, between that of the upper and lower working surfaces of the solid, and both at the models and at the cutting of the stone it was shown that the bed moulds are "short," at one, that is, did not reach to the joint surface, and "full" at the other, that is, projected over to the joint surface at the working surfaces at which they may be applied.

In the system to be now explained the plane upon which the bed mould may be developed is the representation of the actual working surface upon which they are to be transferred,and in the cutting of the stone the one operation only is necessary,that of marking upon the working surfaces the curves and joint lines as given by the bed mould, the application at the joint surfaces of the "plumb bevel" and the attendant shifting of the mould as at the Tangent System being dispensed with altogether, thus doing away with two unnecessary and to the majority of students, two very difficult operations.

At the Prismoidal System after the plan and face moulds are projected, the principal operation consists of ascertaining the size of the smallest prism that will contain the finished solid of the coping, this size is best ascertained by making as in Fig. 2 a vertical projection of the solid, of course selecting a vertical plane most favorable as regard the width of the finished solid. This we take to be one parallel with that of which 6-7 of the plan is the trace, this as may be seen intercepts the plan in the extreme points 6-x of the concave face. The point 6 being the plan of the intersection of the surface forming the concave face with that of the lower joint, and x represents the angle in which the three surfaces forming respectively the upper joint, lower bed, and concave face intersect or meet. We may further remark the trace 6-x, in a manner corresponds to the "seat line" made use of at the Tangent System only at that system the position of the seat line is determined by that of the level (directing) ordinate, here the conditions are reversed, for it is the line 6-x which determines the position of the level plan ordinates; these are of course at right angles with the line in question.

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PLATE 13.

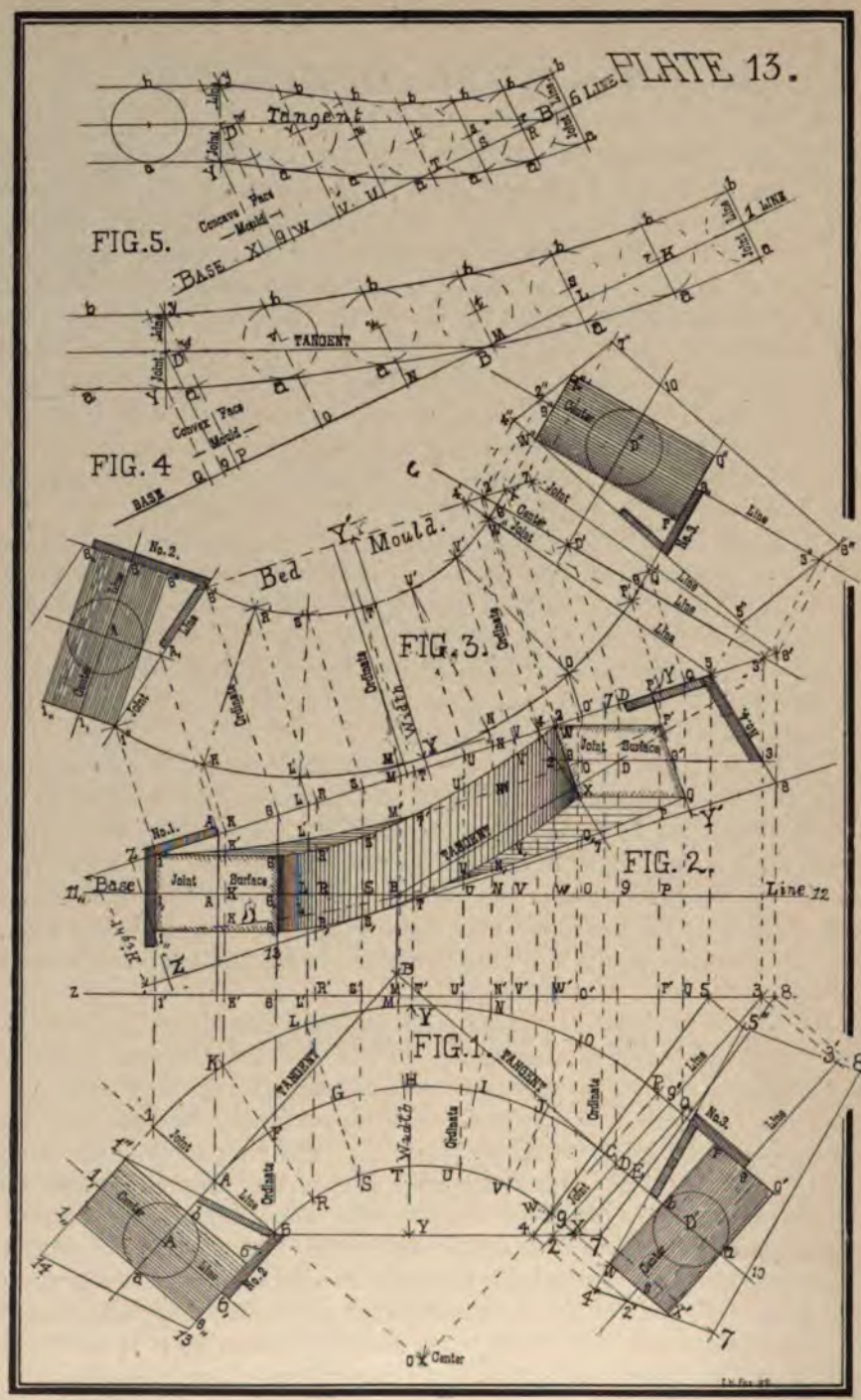
FIG.5.
Tangent
Base
Concave Face Mould
FIG. 4
Bed
Y. Mould.
FIG. 3.
FIG. 2.
Base
Line 12
FIG. 1.
TANGENT
Joint
Surface
Center
No.1.
No.2.
No.3.
Width
Ordinate
Line
0 Center

Understanding this we will explain the simple method by means of which the vertical elevation of the solid Fig. 2 may be projected. Firstly: we may assume that the plain curves, the radials R-K., etc., and plan of upper joint surface, together with the face moulds Figs.4-5, to have already been projected by the methods, fully explained in previous chapters, etc. The student will then at any convenient points draw z-8 of Fig. 1, and the base line 11-12 of Fig. 2 parallel with 6-x of Fig. 1., then from each point as 1-6-R-K-S, etc., at the face curves, square with 6-x produce lines indefinitely. Now to project the representation of the lower joint surface: Set off 1,-1." 1,-1" each equal to the half thickness of the coping, then parallel with the base line draw 1"-6," 1"-6." and the projection desired may be obtained.

To obtain the projection of the upper joint surface: At the vertical projected from the center point D of the joint surface Fig. 1, set off 9-D of Fig. 2 equal to the vertical rise of the coping, [This of course equals 9-D of the face moulds Figs. 4-5] then through D parallel with the base line draw 2-3 indefinitely. This line intercepts the verticals from the points 9-9" of the plan as shown in 9-9' of Fig. 2, with these points as centers and the half thickness of the coping as radius draw arcs in W-X, and Q-P' of the verticals fromcorresponding points of the plan. If the drawing is correct lines parallel with the base line through P'-Q will meet the points given in W-X, also line joining W-X will be parallel with a line joining P'-Q. Now to find points through which to trace the curves: Take for example the points R,'R.' set off R-R' R-R, equal with R-A, and R-B of the concave face mould Fig. 5, this gives in R'-R points through which to trace the projection of the curve of intersection of the upper and lower twisted surfaces with that of the concave face. In a similar manner may a number of points be found. Having traced the curves as shown in the diagram the Vertical projection of the solid may be obtained. Now joining the highest points as 1"-W with the right line Z-8' produced, and a parallel with it to touch the curve as at points, of the concave face, the required thickness of the prism is given in the distance Z-Z between the lines. We may remark the lines Z-8' Z'-8, are the representatives of the upper and under-working surfaces of the prism and upon which the bed mould has to be transferred to give the direction for forming the cylindrical faces of the coping. Now to project the bed mold: From each point as 6-1", A-K, etc., of Z-8', square over the ordinates as shown, set off the length of these respectively equal to that of of the corresponding ordinate of the plan, and through the points given in 1"-K', etc., trace the curves. Then joining 1"-6' the cutting line of the lower joint may be obtained. And joining 2'-3' the projection of the center level line of the upper joint surface is given. To find the projections in which the upper joint surface intercepts the working surface is perhaps the most difficult problem of the constructions, but making use of the geometrical principles taught at the preceding chapters the problem may very readily be solved. First project B the intersection of the plane tangents in B of the base line Fig. 2, joining B with D the vertical projection of the plane tangent with the center point D. of the joint surface may be obtained; then through 2-3 the points in which the center line of the joint surface intercepts the verticals of 2-3 of the plan, at right angles with B-D draw 7'-2-4, and 8,-3-5,' then square with the base line produce in either direction 8-8', 5'-5-X, etc. Then at Fig. 3 square with Z-0 7-7' 4'4, joining 4'-5, the

projection of the line in which the joint surface intersects the upper working surface is given; in a like manner joining 7'8' the similar interesection at the under working surface may be obtained. These are the cutting lines to be transferred to the surface in question, in order to obtain the direction at which to form the joint suface. The student will notice the whole of the joint surface is comprised within the lines 5'-4'-7'-8 and that if the drawing is correct the lines 4'-5 7'9' are parallel. The lower joint being "plumb" the line 1"-6' is the projection of its surface.

Now to construct the representation of the joint surface of the prism, and show the right section of the coping projected thereon: Firstly, we will explain the constructions of Fig. 1: Produce the tangents indefinitely as shown, then square with them at any convenient points as A'-D' draw 1,-6,' and 2'-3, the projections of the level center lines respectively of the two joint surfaces. Now with A'-D' as the centers, and the half thickness of the coping as the radius, draw the arcs a-b as shown, produce 1-14, 8-8', 5'-5". etc.,then parallel with the center lines through a-b draw 1"-b-6," W-B-P., etc., and the section of the coping may be obtained. Now at the upper joint with 2'-3' as the centers and the lengths 3-5, 2-4 of Fig. 2 as the radius cut 5-5, and 4-4, in 4-5', joining these points with the right line as shown gives the projection of the upper working surface; again with 2'-3' as centers and 3-8, and 2-7 of Fig. 2 as the radius, cut 8-8' in 8,' and 4-4' in 4,' joining 8'-7' and the representation of the lower working surface may be obtained. Now at the lower joint surface set off 6-66" equal with 6-6" of Fig. 2, join 6"-1" gives the upper surface, then set off 6-13, 1" 1-14 respectively equal with the corresponding lines of Fig. 2, by joining 13-14 the lower surface line may be obtained. Similar constructions of the joint surface are shown in Fig. 3, the method of projecting them will be obvious on inspection. Now complete the drawing by enclosing the prism within the rectangle Z-Y,Y'-Z which will give in Z-Y' the length in Z,Z' the height, and in Y-Y' of Fig. 1-3 the width of the prism out of which the coping may be formed. Taking respectively the length of radius, width and rise of the coping as equal to that given in plate 12, then Z-Y will equal 6'-1½, Z-Z' 1'-4½ and Y-Y 2'-7", total cubic contents of rough prism 21'-9", or a balance of 10'-9" in favor of the Prismoidal over that of the Tangent System. This shows a great saving of material, and this alone will we believe recommend favorably the Prismoidal System to our practical readers. Now complete the working templates by cutting Nos. 2-3 of Fig. 3, Nos. 1-4 of Fig. 2; their application will be fully explained at plate to follow.

We may remark in closing, that in order to have the diagram Fig 2 as clear as possible and prevent our readers from taking any projection for granted, the projection of the whole solid of the coping has been shown, this has necessitated the drawing of a number of lines which in practice will not be needed, all that is really necessary will be to obtain the projection of the two highest points as Z-W of the joint surfaces, and the lowest point as S at the concave face curve. Then find the center D, together with the tangent B-D of the upper joint surface, then find points 2-3 at the center line, and draw the lines 4-7, and 5-8', Then at the lower joint surface find the position of 1-1," after this draw the parallels Z-8', construct the templates Nos. 1-4 which will complete Fig. 2, and give side of Prism.

Charles H. Fox.

THE VERMONT MARBLE INDUSTRY.*

VERMONT has long been famous for the quantity and quality of the marble produced. The pre-eminence of Vermont in this respect is shown by the fact that in 1890 the marble obtained from the quarries in the United States was valued at $3,488,120, and of this Vermont produced $2,169,560, and I presume these relative values would not be greatly changed by more recent figures, which I am unable to obtain. In absolute quantity, New York exceeds Vermont, but much of its product is fitted only for use as building stone, while much of our marble can be used in statuary and monuments, and therefore has a much greater value. No other state, nor the whole United States, can at all approach Vermont in the quantity and value of the finest grades of marble.

By far the largest part of the marble quarried in Vermont is obtained in Rutland County, though there are a few quarries just south, in Bennington County, and north, in Addison. There are deposits, not now worked, in Chittenden, and quarries of the beautiful Champlain marbles in Franklin County. There are, in all, between thirty and forty quarries, in which are employed over two thousand workmen, the Vermont Marble Company alone employing 1,700. The deposit of marble, so far as now known, begins at the south at Dorset Mountain, and extends northward, in a narrow belt, through Wallingford, West Rutland, Proctor, Pittsford and Brandon, to Middlebury, and there are unworked beds considerably north of the latter place. These are true marbles, metamorphosed limestones. The marble of Swanton and other localities is of different origin, and geologically is not true marble, though just as valuable as if it were, possibly more so. As has already been noticed, the great advantage which Vermont has over other marble producing states is seen in the quality of her marble. Marble good for building is found in many localities, but it is worth only from 75 cents to $2.00 a cubic foot, while marble suitable for monuments sell at from $5 to $7, and statuary brings $12. As the cost of quarring a block of common building marble is the same as if it were of finer grain, it is obvious that a quarry, or deposit of the finer stone is greatly to be desired. Of this finer marble Vermont produces more than seven times as much as does any other state. Nevertheless the use and increasing use of marble as a building stone is not unimportant, for much of our marble is of value chiefly for this purpose, either because of its texture or color.

Beginning our survey of the marble region at Dorset, we find high up on the sides of Dorset Mountain a group, or belt of quarries, some of them not at present worked, which are capable of producing a large amount of fine marble. The largest and most productive quarry is known as Freedly's, carried on, as is the mill at the base of the mountain, by Messrs. J. K. Freedly & Sons. This is a very interesting quarry and one of the oldest, having been worked, it is said, since 1803. It is charmingly located on the east side of the mountain about

*From last Biennial *Report of State Geologist.*

1,000 feet above the beautiful valley. Dorset Mountain is capped by a mass of slate about 500 feet thick, and immediately below this is a great mass of marble, which is several hundred feet thick in some parts of the bed, though much less in other parts. Beneath the marble are great beds of limestone. The marble is rather more coarsely crystalline than that at West Rutland, and some of the layers are rather soft, but most of it is very hard and it is said to be durable. In the Freedly quarry the color varies from pure white, through several shades, clouded and veined, to dark bluish gray. The quarry is partly open and partly "tunnel," that is, the marble has been followed under the slate, leaving, as it has been removed, cavern-like spaces. This "tunnel" is quite large. I should estimate its breadth at seven or eight hundred feet, depth from one hundred to a hundred and fifty feet, and height twenty-five. The massive roof is supported by massive columns left for that purpose. The open quarry is large and both produce abundance of good stone. From the quarry an inclined tramway leads down to the mill, a mile or so below. The track is double, so that a loaded car in descending draws up an empty one on the other track. Most of the product of this quarry goes to Philadelphia. Going south along the east side of the mountain we soon reach a large quarry not now worked called the "Blue Ledge." A very pretty bluish marble is found here and the enormous dump heap shows the extent of past working. Still further south is a very promising look-quarry, also unworked, called the Folsom quarry. There appeared to be an abundance of good stone here awaiting the enterprise of some energetic quarryman. Going on to the southwest side of the mountain we find the Edison quarry which produces a finely veined stone in large blocks, but when sawed the sheets are very likely to be unsound. The quarrymen called my attention to a curious phenomenon which has also been observed in one or two quarries at Pittsford and Brandon. As the surface of the marble deposit is cleared, channelling machines are run back and forth across it until the bed, three, four, six feet deep, as it may happen, is cut into long strips, which are then cut across into blocks. In this quarry these strips when cut spring up from the bed below, so that it is difficult to work, as tools are caught and held. One of the northern quarries was abandoned, I was told, because of the trouble this springing caused.

Farther along the west side of the mountain is a large quarry which is just being opened by the Dorset Mountain Marble Company. There is here a splendid mass of marble of quite varied shading. Borings show a bed of marble several hundred feet thick and apparently very sound, but as to this only trial can determine, for even the most expert quarryman is unable to foretell whether blocks that seem perfectly sound as they are taken out, will prove so, when sawn. A few rods north of this new quarry is an older one formerly known as the Prince quarry, but now worked by the company just mentioned. Considerable marble has been taken from this place and it is still worked. One great obstacle which these Dorset Mountain quarries must overcome is their distance from railroads. Except the Freedly quarry, they must all send the rough stone by teams over a difficult mountain road for several miles. It is fortunate that the hauling is all down hill, so that large loads can be drawn. At the base of the mountain, in Dorset, there are several quarries now abandoned. The largest of these, and one

which was once very actively worked, is that of Kent & Root. This, with the large mill, not far off, now stands deserted and desolate.

So far as I know, marble was quarried at Dorset before it was obtained in any other locality. Says Professor Seely in "The Marble Border of Western New England," to which I am indebted for numerous valuable suggestions and facts: "The first quarry opened at Dorset was by Isaac Underhill in the year 1785 on land owned by Reuben Bloomer and still held by the Bloomer family. The quarry was first wrought for fire jambs, chimney backs, hearths and lintels for the capacious fireplaces of the day. People came a hundred miles for these beautiful fireplace stones and considerable trade in them soon sprang up. Other quarries were soon in operation and from 1785 to 1841 nine quarries were opened."

North of Dorset there were formerly quarries in North Dorset, Danby and Wallingford, but none of these are now worked. Most famous of Vermont marble beds are those at West Rutland, and the name Rutland marble is used in trade to designate either that from these quarries or from Proctor. In this region there are in all about thirty quarries, most of them worked.

Twenty-five of these are controlled by the Vermont Marble Company, which is said to be the largest in the world. The West Rutland quarries are in two groups. Most of them are on the west side of a north and south ridge, extending about half a mile and the stone from these is mostly quite light in color, while a mile and a half north on the same ridge are two quarries which produce no light marble, but a very fine dark stone. There is here a vast deposit of unusually sound and desirable stone, and on the opposite side of the valley there are other fine deposits not worked. The marble is in beds, or layers, which dip to the east at varying inclinations from 20 to 80 deg., the average dip being given as about 45 deg. The beds are together from 50 to over 100 feet thick. The quarries here are really great pits. There is a rectangular opening perhaps 200x250 feet, and the walls descend vertically, or nearly so, to a depth of 200 or in some cases 300 feet.

The first or "covered quarry" is 300 feet deep, and there are two tunnels about 200 feet long, running under the cliffs. Blocks of almost any size which can be moved by the hoisting machines can be obtained from these quarries. The marble in some quarries varies but little from layer to layer, while in others there are several varieties in a single layer. Some layers produce pure white statuary, others most daintily veined or clouded, show a white ground variously streaked, blotched or veined with green, in one bed, blue in another, yellow or light brown in another, olive in another, and it is easily seen that the mixtures and relative amount of these veins in the white ground may be innumerable. I do not know how many shades are recognized in trade, but in the state collection there are blocks which represent twenty varieties. It is said that in one of the West Rutland quarries there are "fifteen different layers varying in thickness from two feet to ten, and varying also in color, texture and value."

The following section, taken from the Eighteenth Annual Report of the U.

S. Geological Survey, will aid the reader in understanding the structure of these quarries:

Blue marble, top	20	feet.
White marble	2	"
Green striped	2	"
White statuary	5-6	"
Striped monumental	2-6	"
White statuary	3-6	"
Layer partly green, partly white	4	"
Green and white "Brocadillo"	2½-3	"
Crinkly, silicious layer, half light, half dark	2-3	"
Light and mottled	4-6	"
Green striped	6	in.
White	2½	"
Half dark green, half white	3-6	"
Italian blue	15-20	"
Mottled limestone		

The two northern quarries, the Esperanza, worked by the Vermont Marble Company, and the True Blue, worked by an independent company, are in the same bed of dark, richly veined and clouded marble, which is very effective for interior work. It seems to be a compact, hard, and durable stone.

Going around, or over this ridge, we find on its eastern slope the old Sutherland Falls quarry at Proctor. This quarry is located in what appears to be a gigantic pocket, or mass of marble enclosed in limestone on all sides. An immense quantity of marble has been taken from it, and at present the walls at the highest point must be 200 feet high, and the area of the floor is three acres. The beds of marble are nearly horizontal, though there is an evident anticlinal arrangement. The marble is mostly rather light, though the dark "mourning vein" is quite dark. These "mourning veins" found in this quarry are very fine. The markings are numerous, almost black, and very wavy. Of this Prof. Seely writes in the "Marble Border": "It would be interesting to know the origin of these mourning marbles, in which the white and black are so curiously mingled. The material giving the black appearance is undoubtedly carbon, and probably in character approaching the graphite, which marks the coarsely crystalline limestone of the Adirondack region. When freely exposed to a high heat the dark color disappeares, leaving a white line. A conjecture might be ventured that the rock was originally of different chemical composition in the different parts; in the white the oxidation of the carbon was complete during metamorphism, while in the dark the oxidation was interfered with. A second conjecture would be that during the metamorphism the particles of carbon moved together and became aggregated, as in the Adirondack marble. The first suggestion is supported by the actual difference in the character of the dark and white portions, the former carrying with it insoluble silicious minerals. A further thought suggests itself, whether the darkly mottled marbles will not be found to be metamorphosed Black River limestone of the New York geologists." I have already noticed that the thickness and extent of the layers in some of the quarries is such that very large blocks can be obtained. In the falls of Otter Creek at Proctor the Vermont Marble Co. have a convenient and most valuable source of power by which to run their mills, for it is obviously cheaper to use water than steam. These falls supply *from 2,000 to 2,500* horse power.

North of Proctor, and between that place and Pittsford, are several quarries, not now worked, and one of considerable importance called the "Mountain Dark," which is in operation. As the name indicates, the marble is of dark bluish color. It is, however, troublesome on account of frequent flaws. Very much of the marble quarried is troublesome and unprofitable on this account, and even in the best quarries the waste is considerable. As has been seen, the quality of the marble cannot always be accurately determined by an inspection of the blocks, and therefore it not infrequently happens that an apparently sound block is transported to the mill and sawed into slabs before its real character is ascertained. If then it be poor, there is not only the loss of the stone, but of all the labor which has been expended upon it. Within the limits of the marble region it is not difficult to find abundant marble. The main trouble is to find that which is sound and perfect when worked. Small specimens are of little value as indicating the soundness of larger pieces, and no one should be misled by them. Almost any quarry will furnish a square foot or so of sound marble, though it may never yield any larger pieces. Several miles north of the Mountain Dark quarry, there are several quarries in Pittsford, all producing a dark marble. It is a handsome stone, but quite liable to imperfection, though good blocks are by no means unattainable.

(*Concluded in next issue.*)

LIMES AND CEMENTS

PHYSICAL TESTS OF PORTLAND CEMENT.

As with the natural cements, we are accustomed to judge of the character of various kinds of Portland cement by certain physical tests as well as by their chemical composition.

In the following table are given the results of the physical examination of certain specimens which illustrate the various types of high-grade Portland cement now found in our market and recently tested in the author's laboratory.

Country.	German	Danish.	English	Belgian.	American.	American.	American.
Brand.	Germania.	Alsen	Brooks & Shoobridge.	High Gr'de	High Grade	Ordinary.	Ordinary.
Residue on 200 mesh	25.9	21.0	23.0	23.0	14.0	23.6	6.8
" " 100 "	6.0	4.0	7.0	10.0	1.5	6.8	.8
" " 50 "	trace	trace	1.0	1.0	trace	.8	.2
Set, initial	3:25'	3:00	1:45'	3:00	4:25'	2:00	:25'
" hard	7:40'	7:00	3:15'	6:00	6:20'	4:45'	1:00
Water for neat mortar	20 p.c.	20 p.c.	19 p.c.	20 p.c.	19 p.c.	19 p.c.	20 p.c.
" " sand "	10 p.c.	10 p.c.	9 p.c.	10 p.c.	9 p.c.	9 p.c.	9 p.c.
Tensile Strength:							
Neat, 1 day					376	260	350
7 days	656	560	596	626	840	496	790
28 "	687	666	464	638	974	678	
3 months					946	740	
Quartz, 3 parts:							
7 days	160	282	120	226	280	162	364
28 "	230	262	192	306	314	218	
3 months					494	244	
Crushing Strength:							
Neat, 7 days	5,458	6,056	4,725	5,091	10,280	5,500	4,950
28 "	6,695	6,761		7,256	11,822	7,412	4,400
3 months					13,250	5,787	
Quartz, 3 parts:							
7 days	1,659	1,321	634	1,601	1,762	1,042	2,137
28 "	1,700	2,157		2,142	2,990	1,712	2,500
3 months					2,923	2,100	

The results of preceding tests show that the Portland cements are distinguished from the natural cements, in addition to differences in characteristics which have already been mentioned, by their slower set, except among some of the inferior brands, and their more rapid acquisition of strength, which is largely completed in from seven to twenty-eight days, although continuing to increase for a year or more. Mortars made with Portland cement are much denser and less porous than those of *natural cement,* due to the greater specific gravity of the cement itself and to the smaller volume of water required.

Amongst themselves the various brands of Portland cement differ very considerably, especially if the inferior Belgian, English, and American cements are included, and more so than would be expected where the limits of composition are so small. The best German Portland cement can, without doubt, be taken as the standard of what is most desirable. When such a cement is mixed with three parts of standard sand it yields a mortar which, according to the requirements of the Association of German Cement Manufacturers, should have a tensile strength of over 227 lbs. per square inch and a crushing strength of 2,275 lbs. per square inch in twenty-eight days, when preserved one day in air and twenty-seven in water of normal temperature. Generally much higher results are obtained in Germany, as may be seen from the results of a test of a sample of German Portland given by Professor Tetmajer, which are as follows:—

SAND MORTAR. 1 TO 3

	Tensile.	Crushing.
7 days	318	2,824
28 "	398	4,082
3 months.	434	4,228
7 "	443	5,004
1 year	605	5,429

Most of the German cements found in our markets fail to reach the high standard, especially of crushing strength, seen in this sample, but the best ones reach the limits which have been mentioned, while the highest grade American cements frequently exceed them, except in crushing strength. The lower results obtained here are very largely due to the differences in the methods of testing employed in the two countries, and not entirely to the nature of the cements themselves.

American cements in some cases have an excessively high tensile strength at early stages of the hardening process without increasing in strength after a few months,

or even deteriorating after that time. This seems to be a peculiarity of the rotary furnace cements, while those burned in kilns are more like the similarly prepared German and Danish products, which gain their tensile strength more slowly, but continue to do so for a long time without reverting. It is plain, therefore, that a cement giving the highest results in tensile strength, especially in the neat form, at an early age, may not be the strongest in this respect after longer periods of time. It will be noticed, however, that the results obtained in tests of the same cement for crushing strength in the form of sand mortar may continue to increase when there is a decrease in the tensile strength and crushing strength in neat mortar after some time. The importance of long-time tests and of determinations of crushing as well as tensile strength are, therefore, apparent in judging of the character of any particular brand.

Our Portland cements are quite as well ground as those which we import, and often are much finer, in the best brands over 80 per cent. passing a sieve of two hundred meshes to the inch and from ninety-five to ninety-eight passing a one hundred mesh sieve. Considering the increased value of finely ground cement, this is an important consideration.

VOLUME CONSTANCY OR SOUNDNESS.

An important determination and consideration in judging a Portland cement is whether it is sound and will not change its volume on age and exposure, losing, at the same time, its strength and coherence. This is usually considered in making tests of cements. It appears form the results of our experiments that many second and third grade cements are not satisfactory in this respect, as some of them check and deteriorate under the conditions of the test. A good Portland cement should show no signs of deterioration in sand mortar even after considerable periods of time, and although it is impossible to always wait for long intervals to settle this point, there are forms of tests which can be so accelerated as to give a result from which more immediate conclusions may be drawn, and it is important that these tests be applied. The best brands, both of foreign and domestic cement, generally prove satisfactory in volume constancy, and when preserved in the form of pats with thin edges for a long time in water, or when the test is accelerated by heat, seldom show any signs of cracking of checking. As the supply of cement of such a quality is plentiful it seems undesirable to use any that will not pass the test, although it may prove unjust in a few instances if applied severely. The methods of making the tests we shall describe later. —Clifford Richardson in "Brickbuilder."

EFFECT OF CONCRETE ON LEAD.

Results of recent English experiments are thus reported:

"If the matrix of the concrete is lime and the concrete is in a damp position, the lime will reduce the metal to ceruse or carbonate of lead, or a crude white lead. If Portland cement instead of lime concrete is used, the lead will be oxidized or reduced to a hard brittle, dirty-red looking material. Examples of such deterioration are frequently found at the junctions of lead soil pipes, as used in England, with stoneware drains, and where pipes pass through walls below the damp course. Lead pipe may be protected by laying it through stoneware drain pipes embedded in the concrete; but in such cases the ends of the pipes should be open, in order to prevent the accumulation therein of carbonic acid gas, which would act injuriously upon the lead. Pitch and asphalt are both good materials for protecting lead pipes that are exposed to corrosive influences. But drain pipes afford the best protection, as the lead pipe can then be withdrawn for repairs."

CONCRETE STAIRS.

A suggestion appears in one of our exchanges regarding concrete stairs. The aggregate owing to its nature and hardness, is liable to wear smooth and slippery on the treads, and to remedy this various methods have been adopted, such as grooving the surface, inserting wood or lead cubes to remedy this slipperyness. The results of these methods have not been altogether satisfactory, the grooves retained dust and the lead or wood are difficult to replace when worn out. The following

method, it is claimed, has proved an effective remedy for this trouble. This is the use of rubber cubes which are made in the form of a screw, so that they can be raised when they become worn, and when finally worn out they can be readily extracted and replaced by new ones. Most people are aware that a staircase always becomes worn in the center, while the ends are never trodden upon, inasmuch as it is impossible to tread within 7 or 8 inches of the wall or handrail. Therefore the rubber cubes in the center of the tread wear out first. Being made to unscrew they can be changed from one position to another until they are all worn out, when new ones can be had. The rubber cubes not only render the treads non-slippery, but afford a firm, noiseles surface.

DEVIATIONS IN THE RESULTS OF CEMENT TESTING.*

Several complaints that tests of Portland cement made at the Royal Testing Laboratory showed more unfavorable results than tests carried out by the manufacturers themselves gave occasion for an investigation as to how far the methods of testing affected the results. The Paper gives the results of the investigation regarding (1) mixing the mortar; (2) making test specimens; (3) removal of the test specimens from the moulds; (4) hardening of the test specimens. It is proposed to institute an investigation of the influence of the the method of carrying out tensile and compressive tests on the results.

The following conclusions are drawn:

(1) In mixing mortar of three parts sand and one part cement the quantity mixed up to 9lb. does not influence the strength of the specimens. The mixing should continue for three minutes; if longer time be taken the strength is slightly reduced. A small quantity of water gives a high tenacity. Five methods of mixing were tried: Steinbruck's mortar-mixer, with 25 revolutions per minute of the mixing arms, gives the highest tenacities. Mixing with a trowel, the sand particles are little if anything reduced in size; in the ball mixer, on the other hand, a considerable reduction takes place. Variations in the proportion of large to small particles of sand, as must occur in practice, have little or no influence on the strength of the specimens. The sand should be well washed, and should contain less than 0.09 per cent. of soluble matter. From the above results it is evident that normal sand should be more clearly defined; it should be taken from the same pit, and should be always under careful control.

(2) The greasing of the moulds should be done with an oil of low viscosity. The quantity of material to be used in each mould should be carefully weighed. Cubes of neat cement are very difficult to make of uniform density. The greatest strength is obtained with 150 strokes of the 4½lb. hammer. A high speed of the hammer lowers the tenacity but raises the compressive strength; a standard speed of fifty strokes per second should be used.

(3) To get trustworthy results, tension and pressure specimens should be carefully smoothed off on the upper surface. Tension specimens should be left ½ hour in the mould, pressure specimens 24 hours.

(4) It is recommended that the specimens be hardened in still water, which should be renewed every 8 days. Slow-setting cements should be preserved from vibrations, as they retard the hardening process. Newly-made specimens should be carefully preserved from air-draughts. In comparative tests of Portland cement the water in which the specimens are hardened should be kept at uniform temperature; the strength of specimens hardened in warm water is higher than that of specimens hardened in cold water.

The Paper is illustrated by numerous diagrams and tables giving the results of tests of 7,700 specimens.

*Foreign Abstract, Institution of Civil Engineers.

BRITISH CEMENT TRADE.

The exports of cement from Great Britain in the nine months ending September 30th are reported as follows, in long tons:

	1897	1898	Changes.
United States ..	57,512	35,748	D. 21,764
British Colonies	100,051	107,823	I. 7,772
Other countries	145,311	109,271	D. 36,040
Totals	302,874	252,842	D. 50,032

It will be seen that the shipments to the United States decreased this year 37.5 per cent., while the total decrease was 16.5 per cent.

THE MARBLE COLLECTIONS OF THE FIELD COLUMBIAN MUSEUM.

FEW marble dealers or architects know that one of the most important collections of marbles in the world may be seen in Chicago. In respect to the size and perfection of the specimens no collection equals it either in this country or abroad. The specimens in the most important European collection, that of the Vienna Museum, are much smaller and therefore do not give as good an idea of each variety. The marble collections of the Field Columbian Museum are installed in the "Marble Room," a hall forty feet square lighted from above. Here about three hundred and fifty polished marble slabs mostly of the uniform size of nine by sixteen inches are displayed in pyramidal form in eight wall cases and two upright center case. A minor collection of one hundred and fifty smaller polished slabs, varying in size from three by four to six inches, is installed with the lithological collections of the adjoining room. Many of these small specimens, however, are duplicates of the marbles in the main collection.

The collection is divided into (a) marbles proper, (b) travertines (onyx marbles), (c) serpentines, and (d) eruptive rocks used for decoration. The marbles are arranged geographically. Under the geographical divisions they are so placed as to produce the most harmonious effect. All the specimens are labelled with the locations of the quarries, the trade names of the varieties and the lithological names where the specimens are other than ordinary marble. This collection has been built up by purchase, by gifts from quarry owners, and by cutting and polishing slabs from marbles received at the close of the World's Fair.

The marbles of France which occupy one of the center cases are easily preeminent in variety and beauty. The Henriettas and the Notre Dame are examples of the many browns and grays, all delicate in color and same in constitution.

The brocatelles furnish yellows; the rouge antique and the griottes, red; the campans with their delicate veinings, green, and the St. Amandes, black. These and intermediate colors occur in many patterns each with its proper name. These marbles have a richness and softness which is unequalled in the rest of the collection. The judgment of the French quarrymen in selecting euphonious names for their marbles is to be commended.

The Italian marbles in the wall case opposite include a number of attractive forms, such as the black and gold Portor so well known from the successful imitations made of it in marbelized slate and the white and violet brecciated paonazetto. The marbles of Greece and Norway which occupy a prominent position in one of the center cases offer strong contrasts. The Norwegian resemble in many respects Georgia marbles. They are coarsely crystalline and vary in color from white to salmon and steel gray with some green. Besides the distribution of the colors in cloudings and indistinct bandings like those of the Georgia marbles, a common marking is what may be described as a partially obliterated breccia Owing to the coarse crystals they have a characteristic sparkle and brilliancy.

The Greek marbles are fine grained and the colors are softer. Among them may be noted a very good black, a number of dove marbles a number of striking reddish-brown breccias and a soft brown with a unique wavy design.

The well-known ivory Numidian and some Egyptian marbles represent Africa, and Asia is represented by a white and gray marble from Hongkong. From Japan come the Ishi-no-tam or balls of stone. These are polished spheres of a breccia marble of Carboniferous age found in Kishni or the Province of Kii where the art of making these balls has been practiced for centuries. In general effect this breccia resembles the best Devon marble.

The marbles of Great Britain are of many varieties, from the white, translucent alabaster of Devon to the black Madrepore marble of Antrim, Ireland. This Madrepore marble has a black background upon which the coralline form of the Madrepore is marked in pure white. The rosewood

VIEW IN THE "MARBLE ROOM" OF FIELD COLUMBIAN MUSEUM, CHICAGO.

VIEW IN THE "MARBLE ROOM" OF FIELD COLUMBIAN MUSEUM, CHICAGO.

marble of Devon, the color of rosewood and with markings closely simulating the grain of wood is a curiosity among marbles. The encrinal marble, really a porous limestone made up of countless crinoid stems, is made to serve as a marble by means of a waxy filling which takes a somewhat resinous polish. Among the most pleasing marbles in the collection are twelve varieties of Ogwell, Ashburton and Pettitor marbles from Devon. The colors are soft and rich and run from a dark rich maroon through brownish red to pearl gray. The pattern may perhaps be described as being usually a mottling.

Among the American marbles the Winooski dolomites of Swanton, Vermont, are conspicuous with their peculiar patterns in dark red and white. In some varieties the color changes to a very attractive violet gray. With but little change in color the pattern varies enough to give nine named varieties. The well-known Vermont marbles are represented by a very complete series of some fifteen specimens. The coarsely crystalline brilliant white, gray and salmon Georgia marbles find their place beside the Vermont specimens. Outside of the Vermont and Georgia stones the collection is very weak in American marbles. The Tennessee and other well-known stones are practically not represented. Practically the only colored breccia to compare favorably with foreign specimens is that of the Point of Pines, Md., not now quarried.

The onyx marbles owing to their nature are represented by slabs of varying size, some larger some smaller than standard. Cylindrical and curious fruit-like forms of Mexican origin give the effect of the onyx banding on curved surfaces. Besides the ordinary "Mexican onyx" from Mexico, Lower California and Arizona less well-known localities such as the new stalagmite marble quarries of Utah are represented. Among other foreign localities Egypt and Syria are represented by travertines of great beauty, the same known as alabaster in Biblical times.

All the serpentines with a pronounced green body color have been labelled, in accord with the recognized tendency of the times, Verde Antique, although many are far removed from the true Verde Antique in color. It is evident that they form a distinct class of decorative stone which needs a name and moreover that they are going to be called Verde Antique anyway. They vary from the deep velvety and slightly mottled green of the true Verde Antique from Greece to the yellow-green, strongly varied colors of the Los Angeles serpentine. With the Verde Antique, but not included among them, are displayed the speckled green and white ophite of New York, the green and white Connemara of Ireland and the curious onion-like Cipollino of Saxony. Certain red and other serpentines displayed here are utilized more for small ornamental forms and turned objects than for architectural purposes. These include a deep green from Santa Catalina Island, a dark green, almost black from Zoblitz, Saxony, and the well-known mottled red of Lizard Point, Cornwall.

Certain of the eruptive rocks are used for decoration. Of interest among these are the porphyries of ancient Rome and a dark green diabase porphyrite of ancient Egypt. One of the most beautiful of such stones is the garnet rock of Xalostoc, Mexico. There is much among this material which equals the best of marble in beauty while such stones of course far excel it in durability. But the excessive cost of working prevents their general use.

Even from this slight sketch of the collection it may readily be seen what opportunities it offers for dealers to enlarge their knowledge of the material they deal in, and for architects to discover the material best suited to any desired decorative effects

Henry W. Nichols.
Assistant Curator Geology, Field Columbian Museum.

CONTRACT NEWS.

Carlisle, Pa.—The First Lutheran Society has decided to purchase a site for the erection of a $16,000 church.

Springfield, O.—The Y. M. C. A. proposes to build a $65,000 modern association building. W. J. Fraser, secretary.

South Haven, Mich.—H. W. and Chas. William contemplate the erection of a $12,000 opera house in the spring.

Allegheny, Pa.—The First National Brewing Co. will build a $500,000 brewery. V. Weir Thalman, architect. The plant will include cooperage plant and ice machinery.

Des Moines, Ia.—Press report states that J. S. Polk will build an eight story business building on the site of the present street car central station. The lower floor to be used as a union station and waiting room for the street car line which he owns. Estimated cost $250,000.

THE SLATE TRADE

THE OLIVE BRANCH IN THE SLATE TRADE.

Slate producers and manufacturers have troubles of their own, it seems. In this, at least, they are in harmony with every branch of the stone business. Their troubles are the consequence, it appears, not so much of commercial conditions as of the business methods pursued by most slate merchants. That is the status, virtually in the building stone trade, in the monumental trade, partly so in the cement industry, particularly in the natural cement end of it, and it is the blighting factor in all competitive industries wherein the strife for trade is excessive and its elasticity stretched to utmost tension.

The slate producers and dealers are manifestly in better form to reform their irregular methods than either of the other stone industries. Slate has the advantage in its ever-broadening utilities and in its ever-expanding markets. The fatalities in these facts lie in the inordinate eagerness of individual operators to expand in a way to contract competition. That method involves sacrifice, of self-interest, in other words to distance competition underselling is resorted to. This is followed by increase in cost of effort. The result is no profit and then the final end—bankruptcy. That's the story a thousand times repeated. A correspondent of the Pen Argyl Index signing himself "F.H.," and who is the operator of a slate quarry, makes the following appeal to the owners and stockholders of slate quarries, to those operating blackboard or structural mills, and any others who wish to see better prices for slate products and higher wages for workmen:

"The situation for the last few years has all been in favor of the consumer of our goods. Prices have gone down and down till now there is almost no profit in the business. The only way we have kept going has been through the foreign demand for roofing slate, through reduction in wages and cutting off every expense possible.

This effort to reduce cost has also caused a depreciation in the quality of our goods and this last in turn has helped to injure the demand for slate in many ways.

"The principal cause for this general decline in prices has been because orders were scarce and most of the mills have been run on the plan of keeping busy even if they were working at a loss. Buyers of our goods have only had to say that they were offered such and such a price and they would get it and no questions asked. Some of the mills seem to have been worked on the idea that if they could not make money they would set a price that would stop any one from making it. Others again seem to have had the idea that there was a fight on and the best thing to do was to put prices down and get orders at any cost. This is not good business and the sooner we quit it the better.

"Slate must be used and there is nothing that can take its place. Anything used in its stead costs more than slate when at its highest price. As far as substitutes compete with structural slate we can as well get 16 as 10 cents. The people we sell to say they would just as soon pay one price as the other. What they want is a stable and uniform scale of prices, all customers being treated alike, large orders and prompt payment getting a legitimate benefit. Underselling and cutting prices does not help our customers nor does it increase our sales. It benefits the few at the expense of the many and injures trade and causes a loss to every one engaged in it.

"We are supposed to be working our quarries to make money. We have found that fighting and cutting prices has not made us rich, nor has it driven all our weak competitors out of business. Now suppose we try peace and make a few dollars for ourselves. Times are improving. Orders are getting plenty and we should take advantage of the present opportunity and make hay while the sun shines. If one half or two-thirds of the mills agree to advance prices and fix them at a uniform scale others will soon follow suit. Some small mills may undersell a little, but they cannot fill all the orders, and we will make more on what we do sell than if we had all the trade at the old prices.

"Our plan is to get up a satisfactory scale of prices, after consulting with all the different quarries, the same to go into effect as soon as two-thirds of the number agree to adopt them. There will be no bond given or penalty attached, but just an honest agreement as among gentlemen not to

break the prices agreed to, except the signer shall give two weeks' notice to all the others of his intention to do so.

"This plan is not opposed by law. It has been tried and works well in other industries and will in this, if we all pull together and act in the right spirit towards each other. What the quarry owners want is more harmony and a better acquaintance among each other. There are more fair, upright and honest men in the business than we realize, and if we knew each other better and worked together for the improvement of our trade we would all make more money in our quarries and it would be a benefit to the whole slate district."

SLATE IN INDIA.

Slate occurs in the Cuddapah, Kistna and Kurnool districts of the Madras Presidency, according to the official "Review of Mineral Production in India." There are no true slates in the Madras Presidency, that is, approaching the roofing slates of commerce. Slabby slates are procurable, but not of large size. Occasionally slaty flags of tolerable size are obtainable. Samples of slate are found near the villages of Mohari and Belgoa, in the Saugor District of the Central Provinces, in the vicinity of the Cawnpur Road. In the Bagalkote taluq of Bijapur a hard rock occurs, which is prized as a building stone. Slate is also found in Jamalpur and Dharrah hills, near Monghyr, and in the Kymore hills, in Shahabad (Bengal); in the Banda, Jhansi, Dehra Dun, Kumaon and Garhwal districts of the Northwest Provinces; in the Simla and the Kangra districts the Panjab, and in the Jaipur, Ulwar and Dholpur States of Rajputana. Metamorphic black slate is stated to occur in the Nemkhara Bhumiat, in the Bhopawar States of the Central India Agency. The stone is used for building, flagging and other masonry structures, but not extensively, as it cannot be easily split into thin slabs.

The estimated production of slate in Monghyr, Bengal, is 750 tons for 1897. A quarry exists near the village of Kuan, in Jabalpur District, in the Central Provinces, but has not as yet been regularly worked. In Rajputana quarries exist in Jaipur, Ulwar, Bundi, Tonk and Dholpur. In Jaipur 9,208 tons, valued at 30,827 rupes were quarried during the year 1897. In Bundi the production was 5,120 tons, valued at 8,750 rupees, and in Tonk it was 2,800 tons, valued at 831 rupees. In Central India metamorphic black slate occurs in Nemkhera, Bhopawar State.

The estimated production of slate in India during 1897 amounted to 26,169 tons, against 22,125 tons in 1896.

AMERICAN VS. WELSH SLATE.

There has been some discussion as to the cost of American roofing slate, delivered in England, as compared with that of Welsh slates from the quarry. We have obtained from the most authentic sources the various items which go to make up the cost of delivering slate from the Pennsylvania quarries to the British consumer, and are thus enabled to make an exact comparison. American slate is sold, as our readers know, by the square —which is 100 square feet as laid on roof; but as many of the transit charges are by the ton, we have reduced the unit to a long ton. As a square will vary little from 650 pounds this gives about 3½ squares to the ton. The price of the quality of slate exported is about $3 per square at quarry; but sales for export have been made at lower rates—we are informed as low as $2.25 a square. An average would probably be not far from $2.50. On this basis we find the cost in London as below:

	U. S.	Sterling.
Slate at quarry, per long ton (2,240 lbs)	$8.75	36s. 6d.
Freight to New York	2.75	11s. 5d.
Ocean freight	3 00	12s. 6d.
Unloading, storing, etc	1.44	6s. 0d.
Total	$15.94	66s. 5d.

The present price of Penrhyn second quality 20 by 10 inch roofing slate at the shipping point in Wales is 142 shillings a thousand. As a thousand would be equivalent to about seven squares of American slate, the Welsh roofing at the quarry would cost 9 shillings more per thousand, than an equivalent quanity of American in London. We have said nothing about the freight on the English railroads, as to all points except in a small district the rates from London would be nearly the same as from the Welsh quarry. It appears, therefore, that at present rates the American slate has slightly the advantage. The variable element, of course, is in the ocean freights, which may cancel the present advantage at any time, or may increase it. — Engineering and Mining Journal.

TIMELY TOPICS

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The Granite-Cutters' Demands. The granite business at the present time is in much better shape than it was one year ago. Should the prospects for current year not be disappointing, it ought not be a great hardship for operators to concede to the demands of the granite cutters on the first of May, 1900, if not before. The proposition for a readjustment of the work-day, and a fixed minimum of wages for it, has had ample time for consideration. The change, if it comes about peacefully, as it should, will be of advantage to the producers—we believe of greater advantage to them than to the granite cutters. Progress in the direction of betterment among those who work for wages cannot be stayed by obstruction on the part of those who must employ workmen to keep their capital employed. The time for opposition of that sort has long since passed, and no intelligent man can be honest with himself who disputes it. The action of the American Federation of Labor, and particularly the initiative of the Granite Cutters' National Union, for an eight-hour work-day and a fixed wage-rate is a tentative proposition that proves itself. Conditions are in order for its success and successful it must be. Already one-third of the number of granite cutters are employed under the eight hour schedule and with the wage rate greater in most cases than the fixed minimum to rule after 1900. Employers should not overlook that fact, if they feel emboldened to resist the demands of the workmen. It would be wiser to prepare for the change that must inevitably come on time.

Looks Like a "Wild-Cat." The prospectus of a recently incorporated stone company, located in Ohio but chartered by the state of South Dakota, "with a capital stock of $200,000 fully paid and non-assessable," contains the following bait for gugdeons: "We have 100 acres of quarry land, 30 minutes ride from Cleveland, on the Valley road; also, another large quarry having the peculiar cutting qualities of stone for pulp, oatmeal, hulling and grindstones. On the grindstones there is a profit of 100 per cent.; on the others just mentioned 300 per cent. profit; on the building and bridge stone 30 per cent. The greater portion of our business is in pulp, hulling and grindstones. We have large orders on hand and prospective orders enough to last for one year ahead. This business is as staple as flour, and the money invested in this is better than government bonds. We know that it will pay you the above profits, but can safely guarantee to stockholders 8 per cent. in gold per annum. * * * The stock will go rapidly to $75 per share within the next six months, and to $100 within a year. We have 20,000 shares of treasury stock for sale at $50 per share to purchase additional machinery." There are many more "flattering inducements" offered for cash in exchange for richly engraved stock certificates, but we need not mention here what they are. The practical stone man, and even a man as insensible as an image of stone, surely won't be taken in on a "graft" that guarantees an average of 200 per cent. profit on "the greater portion of its business" and only 8 per cent. annual dividends, and "the whole durn shootin' match"

paid for! We do not have before us the latest statistics of the exact number and value of millstones used in pulp mills, hulling mills and oatmeal mills, but the total value of these implements consumed annually in the United States for all purposes, we venture, is not above $50,000, and a large portion of the supply comes from Europe. You see, the iron and steel disc and cylindrical mills have been largely adopted in place of millstones for the purpose.

It is different with grindstones, the productive value of which is probably not above $500,000 at the present time, the bulk of which comes from Ohio, and is likely to remain with the companies that have handled the business for years. To establish a competition with them, considering the short margins known to be realized in the business, would be an extra hazardous investment. So, it would appear the prospect for the holders of the 20,000 shares of treasury stock, should it be placed, ever getting back a dollar of it in the shape of dividends, is somewhat precarious. As for building and bridge stone paying 30 per cent. profit everybody in the stone business knows that is not true. We know of some of the best building stone being produced at the present time at a profit of six per cent. and the quarrymen are mighty glad to get that much.

Detroit's Court-House. It is to be hoped the people of Wayne county, Michigan, will have a court-house that will please them when the one now in process of completion shall have been dedicated. If its foundation and superstructure contain more cubic feet of material than the wasted logic and assertion of supervisors, architect, contractors, builders, stone dealers, tax payers and inquisitive citizens, the like for immensity will not be found in this country. Its construction has been a bally-hoo affair from start to stopping-point.

Slates and Strikes. One important result of the Penrhyn slate quarries strike some years ago has not received so much attention as it ought, says the Quarry and Builders' Merchant of London. It was the means of affording an opening there for American slate manufacturers, of which they have taken advantage to good purpose. In 1893 the shipments of American slates to England amounted in value to $1,400; in 1897 the value had risen to $695,000. The trade is chiefly with England; the quantities of American slates sent to the Continent are trifling, and there is every indication that the trade with England is still on the increase. For the fiscal year ending June 30 last, the value of American slates imported into England was $900,000 out of a total shipped to Europe of $1,370,075, and the importation is expected to be considerably larger during the current financial year. The trade is evidently established; it has been created by the Welsh quarrymen's strike. It has recently been frequently suggested, says our contemporary, that the extreme activity in the iron and steel trades there is providing an opportunity for American iron manufacturers, of which they would be sure to avail themselves. If they are as prompt in action as the American slate makers, they will certainly do so, and if they once get a footing they will assuredly maintain it.

The Welsh slate quarrymen, having at last come to a realizing sense of what Yankee enterprise means, are taking steps to break up the destructive competition forced upon them, and will try to do it by slashing prices. In the meantime American producers are opening up

agencies in the principal slate marts of Europe, and preparing the way for a regular fleet of fast vessels to transport the product to them. Your "Uncle Samuel's" notions on commercial expansion is not fixed solely on his recently acquired possessions, but as well on the trade and commerce of the slow-going, but brotherly nations.

Western Stone Stock. The forthcoming annual report of the Western Stone Co., the big stock stone company of the West, it is expected, will show a very gratifying increase in earnings over preceding year. This expectation is foreshadowed in the recent rapid advance of the stock over a dozen points above the dormant quotations of several months ago. On this day's report (Jan. 16) sales of several hundred shares were made at 50 cents, an advance of 15 cents over a month ago. The last annual report was not very comforting to stockholders, except in its hopeful tone.

The St. Louis Dressed Stone Ordinance Illegal. The written opinion recently rendered by Circuit Judge Horatio D. Wood, of St. Louis, knocking out the dressed stone ordinance, in the suit of the St. Louis Quarry and Construction Company, vs. Alice B. Van Versen, et al., has been placed in the court records.

Judge Wood held that the right to contract was as much within the protection of the provisions of the state and federal constitutions as the right to hold property. In his opinion he says: "It follows that a law which takes away from a citizen the right to contract deprives him of his property without due process of law. The ordinance and the contract upon which the bills in suit were issued, which is made subject to said ordinance, prohibit a citizen of this state from contracting outside of the State of Missouri for any of the granite or stone used on the job. The contention, therefore, of the defendants, that this ordinance is unconstitutional, and the contract under which these bills were issued is void, may be well founded, and there are many authorities which sustain this contention."

"The ordinance showed," says Judge Wood, "that the cost of shipping stone in the rough from other states to this city and dressing it here was more than the cost of dressing it at the quarries in such states and shipping it. It was not shown that there was any peculiar advantage in stone dressed in Missouri over stone dressed in any other state, which should call for an ordinance barring the dressed stone of other states.

"The practical effect of the ordinance and contract was to prevent citizens of this state from procuring dressed stone in other states, and to debar citizens of other states from selling in this state dressed stone prepared in such states. This would materially increase the cost of the improvements to the adjacent property owners. It cannot be said that a contract is let to the lowest bidder when competition is excluded.

"The ordinance and contract are clearly violative of section 27, article 6, of the scheme and charter, and are, therefore, void."

Our New Dress. It will be observed STONE puts on a new suit this month. We are certain imperfections will also be observed in the style and fit of the garment wherewith it is clothed. We will get these things in good fashion at our next appearance, however.

BUSINESS TOPICS

Contributed by the National Association of Credit Men.

THE RELATION OF FIRE INSURANCE TO CREDIT.

The constant diminution in the rate per cent. of profits and the marked increase in the cost of doing business, due largely to sharp competition as well as business depression, have well-nigh reduced the business of a wholesale merchant or jobber to profitless transactions. Accordingly, it has become an absolute necessity that losses from bad debts be reduced to a minimum. The jobber, therefore, is forced to give very careful attention to the financial condition of those to whom credit is granted. He must make careful investigation of matters which in the prosperous times of the past have been lightly considered or possibly entirely overlooked. The trained judgment of the credit man, therefore, is being constantly exercised concerning those things which tend to make credit-giving a risk that is not warranted by the present condition. If the retail merchant only realized this he would cease to take offense when he is courteously asked for particulars with respect to his affairs.

Insurance has come to be recognized as one of the most important elements entering into the question of credit. Next to the trusting out of goods, insurance against fire is the most important matter. Nevertheless, there are many merchants who fail to give insurance that consideration to which it is entitled. It is often found in investigating statements that either no insurance at all is carried or else that the insurance is very small compared with the value of the stock on hand.

The retail merchant should realize that when he buys goods upon credit without taking out a proper insurance that he asks the jobber to assume a double risk. First there is the ordinary risk and second there is the risk from fire. Almost invariably the goods remaining in the warehouses of the jobbers are amply insured. When the goods are transferred from the jobber's warehouse to the store of the retailer they should likewise be insured against fire.

If insurance is being neglected from lack of appreciation of its importance that fact may indicate to the creditor that the business methods in general of the merchant are more or less slack. If he is heedless of insurance, which is so vitally important, very naturally he may be suspected of trusting out his goods too freely and to be an indifferent collector and also a careless buyer. Straws show which way the wind blows, and the manner in which insurance is managed is a straw in the wind which the jobber is prone to watch very closely.

The high rates for insurance prevailing in towns and villages is often given as a reason for not carrying insurance or for carrying limited amounts only. Does it never occur to the retail merchant that the only reason for high rates is that on the average fires in such localities are more frequent and more disastrous than in better protected places? Insurance premiums are based upon the quality of the risk. The higher the rate is that the insurance companies name, the greater the danger is that they knew to exist; hence the greater need to the merchant of the protection that insurance gives.

For the country merchant to carry any part of the risk himself is to be penny wise and pound foolish. Such a course is unjust to those who extend credit to him. Accordingly he should not be surprised when pursuing this course, if, in some cases, credit is absolutely withheld until his stock is sufficiently insured.

The unwisdom of neglecting insurance on the score of economy becomes apparent on some unfortunate day, when the merchant's stock is consumed by fire and the earnings and accumulations of years vanish in an hour. If the stock had been properly insured there would be enough to meet business obligations and start anew. If it was not properly insured then all is lost and capital and credit are both gone. Insurance is a subject worthy of most careful thought upon the part of every business man. If there has been neglect in this regard the remedy should be applied at once. It will have the effect of renewing confidence and strengthening credit, as well as protecting the business, the home and the family. Every merchant's rule should be to keep well insured in good companies and never to allow policies to lapse.

The Standard granite company at Quincy, Mass., have disposed of their quarries to James A Penniman and George D. Harriman, of Plymouth, N. H.

Sam J. Buquo, agent, has purchased the lime and stone plants of Harris & Buquo at Erin, Tenn., for $12,000. The property is valued at $50,000.

LEGAL DECISIONS.

WHAT CONSTITUTES USE OF PARTY WALL.

Under a party wall agreement one party was to be liable for half the cost of a wall built by the other whenever he built to such wall. He built a studded wall next to the party wall, touching it and cemented to it, to keep out the moisture. The court held that this constituted such a use of the walls as to make him liable under the agreement. Such an agreement also binds the purchaser of the property if he avails himself of its benefits.—Harris vs. Dozier, 72 Ill. App. Ct. Rep., 542.

RISKS ASSUMED BY WORKMEN ON BUILDING.

The obligation of an employer to furnish safe places for his men to work upon does not impose upon him the duty of keeping a building which they are employed in erecting in a safe condition at every moment of their work. The hazard of working upon such a building is an ordinary hazard, incident to the employment, and therefore assumed by the employee.—Richardson vs. Anglo-Amer. Prov. Co., 72 Ill. App. Ct. Rep., 77.

ARCHITECT'S CERTIFICATE AND SUIT FOR DAMAGES.

A contract provided that on failure of the contractor to do any of the work required the other party should, upon the architect's certificate of such neglect, be at liberty to terminate the employment and complete the work himself; his expenses to be audited by the architect, whose certificate should be conclusive. The court held that an action for a breach of the contract and for expenses incurred for labor and materials furnished for same could not be maintained without the certificate of the architect, unless sufficient excuse for failure to procure same was shown.—Int. Cement Co. vs. Beifeld, Ill., 50 N. E. Rep., 716.

LIQUIDATED DAMAGES AND PENALTIES.

A stipulation in a building contract providing that the contractor shall forfeit $10 for each day after a certain day that the building, contracted to be built for $6,900, remains uncompleted, will be treated as a penalty, where there is a failure to show that any damages actually resulted from such delay.—Conneley vs. Priest, 72 Mo. App. Ct. Rep., 674.

WHAT SUB-CONTRACTOR MUST SHOW IN SUPPORT OF CLAIM.

A sub-contractor, in attempting to enforce a lien, must show that there was something due to the principal contractor at the time of filing the lien, or at the time he gave legal notice of his contract, or that thereafter a sum became due which would be applicable under the law to the payment of his debt to the claimant.—Madden vs. Lennon, 52 N. Y. Supp. *Rep., 8.*

NEED NOT FENCE TOPS OF PARTY WALLS.

An owner of premises partly covered by a building, and bounded by party walls, is under no obligation to fence the top of the party walls so as to prevent persons who may be on the roof of adjoining buildings from falling over into his yard.—Woods vs. Miller, 52 N. Y. Supp. Rep., 217.

RIGHT IN WALL ACQUIRED BY USE.

Where a wall is built as part of a house, and used for over 20 years by the owner, the subsequent use of the wall by the owner of an adjoining lot will not deprive the original owner of the possession of same, although such use may entitle the adjoining owner to an easement.—Pearsall vs. Westcott, 51 N. Y. Supp. Ct. Rep., 663.

EFFECT OF PURCHASE ON EASEMENT.

Where the owner of a lot on which there is a building whose wall encroaches on the adjoining land acquires title to the latter, the encroachment ceases, and even if he subsequently severs the title to the lots the adjoining lot is charged with the servitude of the wall, and the title to the dominant lot is not open to objection that it encroaches on the adjoining lot.—Griffin vs. Baust, 50 N. Y. Supp. Rep.

A CONTRACT THAT CANNOT BE ENFORCED.

A promise by the builder to pay a contractor for material rejected by the architect, without the authority conferred upon him by the contract, is without consideration and cannot be enforced.—Brin vs. McGregor, Texas, 45 S. W. Rep., 923.

WHEN ARCHITECTS ARE TO DECIDE.

Under an agreement in a building contract that the decision of the architects and engineers shall be final in all disputes "relative to or touching" the contract, an alleged wrongful dismissal of one of the parties from employment under the contract must be submitted to them for final decision.—Mitechell vs. Dougherty, U. S. Cir. Ct., 86 Fed. Rep., 859.

And: Where a builder and a contractor, by their written contract, make the supervising architect the judge of the proper performance of the contract, neither party can avoid the judgment of such architect without showing that he acted capriciously, arbitrarily or fraudulently.—Brin vs. McGregor, Texas, 45 S. W. Rep., 924.

WHEN LOWEST BIDDER CANNOT RECOVER DAMAGES.

The lowest bidder for the construction of a building, who fails to execute a bond, or to sign a contract for the erection of the building, as he understood he should, cannot maintain an action for damages for breach of contract upon his bid.—Hogan vs. Shields, Mont., 52 Pacific Rep., 55.

SELECTED MISCELLANY

THE MAYOR OF SAGETOWN.

Hain't ever been in Sagetown Say, you've
made a big mistake!
I doubt ef you could find a place 'at's half
ez wide awake.
It's jest a-boomin' night an' day an' spread-
in' in extent,
All owin' to the Mayor who's a enterprisin'
gent.

The town received its cognomen from sage-
brush which, you know,
Is growin' all about it, an' folks used to call
it slow,
Till Doc. Briggs happens 'long an' says he
thinks he'll settle down,
An' straightway gives it out 'at he's the
Mayor of the town.

We'd never hed a mayor—never thought it
worth the while
Till Doc. shows up an' tells us we are 'way
behin' the style.
He holds no 'lection but he shows 'at he
can shoot to kill,
An' says, "Now I'll be Mayor er, 'y gad,
we'll see who will!"

Doc. 'lows 'at 'lections is a fraud, an' men
'at hez the rocks
Hev got it in their power fer to stuff the
ballot-box.
"While I'm runnin' things," sez Doc., an'
says it firm an' flat,
"I'll steer the town to suit myself an' let
it go at that."

Doc.'s simple in his methods—says 'twould
complicate his plans
To hev some other officers a-tyin' up his
hands.
He's mayor, clerk, town treasurer, judge,
coroner, an' all.
Fer when it comes to gover'ment, why Doc.
hez got the call.

Doc. tries to git a drunk at 3:00 a. m., one
winter night,
An', strange enough, they ain't a joint 'at
shows a gleam o' light.
An' then Doc. frames a law which says 'at
when, by night er day,
A joint locks up, it's got to pack its traps
an' git away.

An' then Doc. moves his office to the big
Red Front Saloon,
An' business at that fount o' joy is rushin',
mighty soon,
Fer everybody knows 'at Doc. is rakin' in
his share,
An' that it's safer all erround to buy their
whiskey there.

Doc.'s great fer havin' hangin's; says they
boom the town a heap,
An' draw a crowd from fer an near; an'
more 'an that, they're cheap.
An' so he hez one every month an' does
the best he can
To hev the victim somethin' more than jest
a common man.

One time a blamed Perfessor from some
down-east college place,
He criticized Doc.'s grammar an' it proved
a fatal case.
Doc. advertised his hangin'-bee fer all 'at it
was worth,—
"The first bang-up Perfessor 'at was ever
hung on earth!"

Doc. made our town the rendyvoo fer cow-
boys fer an' near,
But still it wa'n't the county-seat till Doc.
he says, "See here,
Be we a-goin' to set erround an' let some
other place
'At ain't got half our stock o' nerve throw
gravel in our face?"

So one night Doc. sort o' steers a gang o'
loyal men
To that there rival layout, an' when mornin'
comes agen
Doc. gallops proudly up an' down through
Sagetown's only street
A-shoutin', "Hear ye! Hear ye! We hev
moved the county-seat!"

O' course some folks don't cotton to Doc.'s
enterprisin' ways,
But anyone 'at ever sees Doc. make his pis-
tol plays
An' watches him come out on top in every
sort o' fight
Will never hesitate to say he thinks 'at
Doc.'s all right.

Doc.'s goin' to be the Gov'ner o' the State,
er so I've heard.
Well, any place 'at Doc. shows up they'll
find 'at he's a bird.
An' some day he'll be President, an' then,
I'll bet my soul,
This land, inside o' thirty days, 'll reach
from pole to pole.

—Nixon Waterman in L. A. W. Bulletin.

Resisting Power of Iron Against Fire.

In an article in Stahl und Eisen, it is stated that the best protector for iron in the construction of buildings is cement. By exposing pieces of iron which had been interred for a long time in cement, it was proved that rust cannot assail iron so protected, provided the cement envelops the iron round about, so that no hollow spaces exist between the iron and the coat of cement. Slag cement would not be suitable, as it contains acids. The destruction of iron and stone buildings which were supposed to be proof against fire show that they had no claim to be so considered; they often fell in shortly after the outbreak of fire. It was, however, discovered later that the collapse was due to the metal parts, which were mostly cast or wrought iron, losing their carrying power.

From this it was recognized that the iron had to be protected from the direct action of the fire, thereby preventing the loss of carrying power and expansion. The municipal government of Hamburg caused exhaustive tests to be made, identical in all respects to the conditions to be met with in a great conflagration, and these tests included cast and wrought iron and wooden supports. The supports were placed upright into an iron frame, and hydraulic pressure of about 15,000 pounds to the square inch put on. To heat the supports a furnace lined with firebrick and provided with gas burners was used. The furnace consisted of two parts, which could be closed and opened at will, and arranged on upright shafts. The supports passed through the furnace so that a little space was left between the supports and top and bottom of furnace, and permitting the introduction of air from below and exhausting the gases of combustion above.

According as the heat was regulated faster or slower it was shown that unprotected iron supports lost their carrying power in from seventeen to fifty-nine minutes. The supports filled with mortar scarcely showed any better results, and proved again the necessity of encasing the supports by a fireproof or non-conducting material, which would delay the advance of heat to the iron, and possess sufficient strength to resist the shock of the falling debris and the stream of water thrown by a fire engine.

In the subsequent tests the supports were encased in slabs of plaster of paris, xylite, or stone, wood, asbestos, cement, etc. The iron supports provided with such a casing retained their carrying power for as long as three hours and fifty-six minutes. An oaken support without casing withstood a similar pressure in the fire for only one hour and twenty-one minutes. The heat of the flame ranged from 1,100 to 1,300 degrees Centigrade.

Des Moines, Ia.—Proudfoot & Bird have completed plans for the erection of a $25,000 residence for Mrs. *Augusta V. Morse.*

Strength of Boiler Seams.

The proportionate strenght of single and double-riveted seams is given by Fairburn as about 56 to 70. Many people are in doubt as to just why the longitudinal seams in a boiler are double-riveted while the other seams are only single-riveted. This can be determined mathematically in the following manner: The shell of a one-fourth inch iron boiler is 44 inches in diameter and the steam pressure is 80 pounds. To ascertain the strain to part the boiler, for an inch in length, the diameter should be multiplied by one and by the pressure per square inch; i. e., 80X1X44=3,520 pounds. Since there is one-fourth inch of metal on either side, one-half a square inch of the boiler is subjected to a pressure or strain of 3,520 pounds. Or, the total strain on the boiler acting in a longitudinal direction is 7,040 pounds. To find the strain on the roundabout seams, the area of one of the heads is multiplied by the boiler pressure per square inch. 3.1416X44=138.2 inches, the circumference of one of the heads. The area is found to be 3.1416X222=1,520.53 square inches and multiplied by 80=121,642.4 pounds, the strain to part the boiler. To resist this strain, there is 138.2X¼=34.5 inches of metal. This is subjected to a strain of 121,642.4÷34.5=3,525 pounds per square inch. This is approximately half the strain to which the boiler is exposed in the direction of the longitudinal seam. It is for this reason that longitudinal seams are generally double and sometimes triple riveted. —The Engineer.

Percussion Core-Drills.

But little use has hitherto been made of percussion drills for core-cutting, and particularly the recovery of stone cores, the diamond drill being almost exclusively used. An altered state of things has, however, arisen since the introduction of the improved Fauck drill without a walking beam, whereby a short stroke and high speed can be obtained. When a water flush is used a chisel crown can be used with advantage, the sole of the borehole being then quite clean; otherwise, if the hole is not flushed out the crown cannot penetrate the detritus at the bottom, and hence is very liable to jam. On the other hand, a wedge-shaped chisel having a longer stroke, though better able to penetrate the mass, loses a great part of its effective force in so doing.

When the borehole is clear in the sole it is feasible to so dispose of the engaging cutter of the chisel that the expansion is greatly increased, and in the chisel-crown an expanded development of the chisel cutters becomes possible. Given the same force of impact in both cases, the ordinary chisel will strike deeper into the sole, but thereby encounters an increased resistance. The chisel crown being broader in the cutters, is prevented from driving so far into the sole, but works easier and at the same time

acts upon a larger surface of the borehole at each stroke than the chisel does.

The drill employed is traversed by a longitudinal channel so that the walls and aperture are of about equal dimensions. At the drill head the walls are bulged outward a little towards the circumference of the borehole, so as to form a cylindrical hollow space between the latter and the drill. The head of the drill is formed of a number of radially-arranged chisel cutters, and the water flush, which is supplied through the central channel, escapes through the apertures between the cutters, and carries the detritus upwards through the cylindrical hollow space.

The crown-shaped arrangement of the cutters possesses the following advantages:—(1) Uniform and continuous recovery of cores, as with the diamond drill; (2) reduction of labor, a stone core being left; (3) obviation of all the disadvantages, e. g., irregular and sloping boreholes, of the chisel drill.

The results of the first trials, were, in consequence, highly favorable, the efficiency of the tool being 20 to 30 per cent. greater than that of the ordinary chisel.

Another advantage of the chisel crown is that the core can be very easily removed, since it is lifted by merely reversing the direction of the waterflush; the vibration produced by the rapid stroke of the drill suffices to break off the core, which is then raised by the water. The vibration also prevents the core from jamming in the drill; the cores are surprisingly smooth and uniform in shape, and as no core-fishing tool is required the drill rods do not need to be enlarged.

To render the appliance suitable for all cases it is necessary that the cores obtained should be of relatively smaller diameter than those formed by the diamond drill, in order that they may break more easily and be readily forced up through the ordinary holly drill rods, the speed of water necessary to attain this end being more readily produced in a small tube. As a small core is just as useful in practice as a large one, the method is, therefore, universally applicable.

The favorable working of the drill is greatly dependent on the new mechanism invented by the author for producing the stroke. Diagrams show that the curve resembles that of a free-fall drill, and the ascending lines denoting the rebound at each stroke indicate a very effective blow. As the effect of a free-fall drill with a stroke of only 2 in. is a final velocity of about 40 in., the efficiency of the method in hard rock is explained, because the new drill gives four times as many blows as the drill with jars, and that, too, on a clear sole. In boring through a very hard rock over 20 yards thick at Kroscienko the new Fauck drill proved itself from five to ten times as effective as the jars drill. The hardness of the stone is evidenced by the fact that 1¼ in. were worn off the under-reamer in a very short time.

Thus, from the circumstances that the chisel-crown drill requires neither a core-fisher nor wider rod tubes than usual, whilst the core is brought up automatically, and at the same time the borehole can be widened below the casing, it is evident that the problem of core-recovery has been solvd in a very simple and complete manner.—Fauck in Berg- und Huttenmannische Zeitung.

Making Gun Cotton.

Gun cotton is made by immersing cold, thoroughly dried and thoroughly cleansed cotton fibre in a mixture of nitric and sulphuric acids, when nitrogen oxides from the nitric acid replace part of the atoms of hydrogen in the molecules of the cotton, or cellulose, as it is called by the chemists.

If the acids are the strongest that are made and the temperature during nitration is kept low, and the immersion lasts for several hours, the greatest degree of replacement of hydrogen atoms by nitrogen oxide groups takes place; but if the temperature rises or the acid mixture is weak and the time of immersion is short, fewer of the hydrogen atoms of the cellulose molecule are replaced, and by taking advantage of these conditions we obtain cellulose nitrates containing from four to eleven atoms of nitrogen in the molecule, and each of these nitrates possesses different properties, but all of them have, by this treatment, become to a degree explosive, their explosibility increasing with the increase in their nitrogen contents.

It may appear singular that further contact with acid, and especially sulphuric acid, will cause the decomposition of these cellulose nitrates; yet such is the case, and therefore it is necessary, after nitration, to free the cellulose nitrates rapidly and completely from the acids present, which is done by wringing out the mass in a centrifugal machine and immersing the mass in a tank containing a large volume of rapidly changing water, in which the cellulose nitrate is kept in agitation by a revolving feather wheel; afterwards it is boiled with water which usually contains a small quantity of sodium carbonate.

As, however, the cotton fibre is in the form of capillary tubes of considerable length, this washing and boiling does not suffice to remove the acid from the interior of the tubes; the material is, therefore, put into a pulper, or rag-engine such as is used in paper-making, and pulped to the fineness of corn meal, while at the same time it is washed by a continuous change of water until by chemical tests it is found to be free from acids.

None of the cellulose nitrates before pulping and when dry present any different appearance to the eye from the cotton from which they were made, but they have a harsher feel. They all burn much more readily when ignited, and the higher-nitra-

tion ones especially flash off instantly without producing any smoke or leaving any appreciable residue. Unlike cellulose, the cellulose nitrates of lower nitration are soluble in a mixture of ether and alcohol, while the higher ones are not so, but are soluble in acetone. The nitrates soluble in ether-alcohol are known as pyroxylin or collodion gun-cotton, and are used in the manufacture of celluloid, collodion and like substances, while the nitrates of the highest nitration are more specifically known as gun-cotton or military gun-cotton..

It is this latter which has been used for filling torpedoes, mines, and shell, and for purposes of demolitions.—Professor Charles E. Munroe in Cassier's Magazine for December.

Some High-Explosive Effects.

Among the many accidents which are on record, one of the most notable is that of the explosion of 55 tons of blasting gelatine which was being unloaded from a railway train at Braamfontein, 300 yards west of Johannesburg, in South Africa, on February 19, 1896, and which was exploded by an end-on collision. The result of the explosion of this enormous quantity of one of the most powerful explosives used was to produce a crater 300 feet long, 65 feet wide, and 30 feet deep in soft ground; or, taking a cubic foot of earth as weighing 100 pounds, the superficial explosion of this 55 tons of explosive gelatine excavated about 30,000 tons of soft earth.

Besides this, there was a total destruction of all buildings within a radius of 330 yards, while from that distance to 660 yards all the buildings were shattered, and the roofs were battered in up to about 1000 yards; but all these buildings were built chiefly of corrugated iron and mud, and therefore were of a most unsubstantial character.

On the other hand, we have in the United States the blowing up of the Hudson river Palisades at Fort Lee in 1893, when the explosion of two tons of dynamite, placed in a chamber in the rock, brought down 100,000 tons of rock; the blasting at the Dinorwic Quarries, Lamberis, in the same year, when two and one-half tons of gelatine-dynamite, placed in chambers in the dyke, overthrew 180,000 tons of rock; and the destruction of the famous Talcen Mawr in 1895, when seven tons of powder, poured into two shafts, dislodged a mass of rock computed to weigh from 125,000 to 200,000 tons.

From this we find that the dynamite on the interior at Fort Lee was over forty times as efficient as the explosive gelatine on the surface at Johannesburg, while the powder at Talcen Mawr was over forty-two times as efficient. It is, hence, not surprising that the superficial explosion of the 300-pound charges of gun-cotton thrown by the Vesuvius' guns at Santiago during the late war between the United States and Spain produced no serious structural damage, and simply harassed the enemy by their frightful reports, which occurred at infrequent intervals and unexpected times. — Professor Charles E. Munro in Cassier's Magazine for December

Eastern Art.

The most essential difference between Oriental and Western art is that in the East the people decorate the great, and in the West the small. Oriental grandeur consists in the magnificance of cities, gardens, and great sweeps of surfaces, whereas Western aestheticism delights in the details of statuary, canvas, plaques and tidies. The East gave a wider sweep to the imagination. Sky and mountains were the nature which most interested the people, and not the shady nooks and frost-crystals. The shepherds of the Syrian plains, watching their flocks by night under the great dome of the heavens, watched at the same time the flocks of stars and the clouds that rolled above them, and the habitual sight of such things gave them a taste for magnificence. Looking at the great rather than the small, and looking up rather than down, they developed astronomy as the first science, and studied the heavens before they knew much about the earth —leaving geology and the other terrestrial sciences to be developd by the Western peoples. They sought, for the same reason, to learn about God before they knew much about man, completing the science of theology before than of anthropology and sociology was begun. In their fondness for universals they speculated as philosophers before they observed as scientists, so that the world as a whole was known before its parts, and cosmologies and theories of the universe engaged their attention as fit companions for the grandeur of their artistic conceptions. The East early learned to commune with the great, and hence magnificence was its first product. A people which sees nothing less than mountains and skies cannot be content with the petty in art. Wild flights, like those of the eagle and the lightning, are more native to them. Like the Swiss and the Scotch, the highlanders of Palestine and Chaldea inherited a bold and free soul, and their imaginations were no tamer than the chamois which sported among the cliffs, or the spirit of liberty there.—Austin Bierbower, in December Lippincott's.

Clean Road Metal.

A principle learned from MacAdam was that "broken stone, pressed and compacted, would co-here together and, by the mutual friction of its parts, bear and distribute heavy pressures as well as if it actually were the smooth and solid slab it seems." But when earth is mixed with the stone the friction is reduced by nearly one-half, the material is less compact and firm and is much less capable of bearing heavy loads.

Moisture affects the volume of clay. Roads in which it is used rut badly in wet weather, even though they are very thick, while thinner roads in which it is not used, but in which the stones are pressed together by their own angles through adequate rolling, remain firm and smooth. Road metal should be clean, and free from clay. The use of clay is attractive, because, with it, light rolling seems to give a good smooth surface, but this is only temporary and is unsatisfactory and expensive in the end.—L. A. W. Bulletin.

Superb Statue of Saint Margaret.

"But today He found another
Margaret both in deed and name;
Whom, because He dearly loved her,
Sing we now with glad acclaim."

The statue of Saint Margaret of Antioch, recently put in place in St. Paul's Episcopal cathedral at Fond du Lac, is one of the finest pieces of sculpture in Wisconsin; indeed, there are said to be not a half dozen pieces of its equal in this country. It was executed by Miss Mary Grant of London for the Paris exposition, where it received the gold medal. Canon Farrar desired it for his chapel at Westminster Abbey, but Bishop Grafton was fortunate enough to get it.

The statue is 9 feet 2 inches high of Carrara marble and stands upon a pedestal 2 feet and 8 inches high, made of Belgian granite.

Saint Margaret of Antioch has been the hope and despair of sculptors for generations. It is one of the most lovely subjects in all legendary art. It is a sermon in marble, and is impressively beautiful. Margaret was the daughter of a priest of Antioch, and being delicate was sent to be nursed in the country. Her nurse being in secret a Christian, the young child was early reared in the Christian faith. In the course of time, Olybrius, governor of Antioch, seeing Margaret, became intoxicated by her rare beauty, and sought her in marriage. This she repudiated, confessing herself to be a Christian. As a penalty for not accepting the overtures of the heathen governor, she was dragged to a dungeon, where, it is related, Satan, in the form of a terrible dragon, came upon her with his inflamed and hideous mouth open, and sought to terrify and confound her. Margaret, the very incarnation of love, purity and faith, holds up the cross before the dragon, and by its power, he is subdued and flees from her. It is while holding the uplifted cross that the statue impersonates Saint Margaret.

Uniform Tints on Stone.

If the surface of a stone is washed clean, and, after drying, is painted with one or more coats of boiled linseed oil, and finally with a weak solution of ammonia in warm water, the tints will be more uniform. This method has been tried on several houses in New York City, and the waterproof coating thus produced is found to last four or five

when it must be renewed. The prepa- used in coating the Egyptian obelisk ntral Park is said to have consisted raffine containing creosote dissolved in ıtine, the creosote being considered effi- ıs in preventing organic growth upon tone. The melting point of the com- is about 140 degrees Fahr. In apply- he surface to be coated is first heated eans of especially designed lamps and oal stoves, and the melted compound d with a brush. On cooling it is ab- d to a depth depending upon the de- of penetration of the heat, in the case obelisk about one-half inch.—Scientific ican.

e Method of Erecting Egyptian Obelisks.

late issue of "Construction Moderne." . C. Kruseman suggests a possible d of handling blocks of stone weigh- much as 1,000 tons, and sometimes 131 h and 10 ft. square at the base. These were also placed on pedestals consid- raised above the actual level of the Mr. Kruseman finds that these obelisks generally placed in front of pylons or es. He believes that the Egyptians built a slightly inclined causeway of or other material, equal in height at ıd to the obelisk to be erected; ending e end in a strong wooden crib, and g a space between the crib and the for the obelisk. The base was then ınd the space between the temple and ib was about half filled with sand; and e face of the crib a strong inclined was constructed leading to the base. belisk was then rolled up the incline rd wooden rollers; and, with tackle g to the temple, it was then allowed over the front of the crib, falling he sand and guided by the chute. By and carefully digging away the sand auling on the top of the obelisk it thus be gradually sunk, until it would rest on its base.

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aukee, Wis.—The committee of House rrection of the county board has un- onsideration the building of a stone an addition to the cell house, a new age system and a new power house. mprovements will cost in the neigh- d of $100,000.

John, Mich.—The Congregational So- will build a $15,000 church in the .

Orleans, La.—The Louisville & Nash- Ry. will build a $50,000 depot. R. ort, chief engineer, Louisville, Ky.

gantown, W. Va.—The Methodist So- s arranging to build a $25,000 church.

Craftsmen in Jerusalem.

The workmen who built the German church in Jerusalem did the work with the same ease which belongs to their occidental

STONE CUTTERS.

brothers, though they wore white turbans and gowns, which did not seem to interfere with their stone cutting and lifting.

STONE MASONS.

These are masons engaged in building the new German church at Jerusalem.

Their voluminous "bloomers" and skirts do not seem to interfere with their agility, for they run up the ladder with no difficulty and do their work sucessfully.

Whitesboro, N. Y.—The Baptist Church has been destroyed by fire. Loss $10,000. A legacy of $8,000 was received by this church a few years ago, and this with the insurance, it is thought, will enable the congregation to build a handsome structure. Rev. F. W. Kneeland, pastor.

Centralia, Ill.—The Baptist Society will build a $12,000 church.

SITUATIONS WANTED.

Advertisements under this heading inserted for subscribers to STONE *free of charge. Advertiser must send 25 cents to pay postage, if replies are to be addressed in care of* STONE. *Rate to non-subscribers, 10 cents per line each insertion.*

WANTED—Position; 16 years' experience as foreman and superintendent in general contract work, quarries and heavy masonry; expert on broken ashlar work. First-class references furnished. Address J. B. GORDON, Roscoe, New York.

A MAN who is thoroughly acquainted with the Granite Business in all its details, having an experience of 15 years, wishes to correspond with reliable wholesale manufacturer or quarryman regarding a situation, either for road or office position, after January 1, 1899. Correspondence confidential. Address G. B., care of STONE.

SITUATION WANTED by Architect and Monumental Carver; one who can do general work; 18 years experience; young married man. Address R. H. MOONEY, Harvey, Ill.

HELP WANTED.

Advertisements under this heading 10 cents per line each insertion.

HELP WANTED.—A man who thoroughly understands cutting and polishing onyx, and can take charge of a small plant. Address Editor of STONE.

HELP WANTED—Sawyer for marble and stone. Address ALBERT WEIBLEN, New Orleans, La.

TO SELL. TO BUY. TO EXCHANGE

Advertisements inserted in this department for 15 cents per line each insertion.

FOR SALE—Nos. 2 and 3 Gates Gyratory Crushers. One 12-ton steam roller, cheap. A. N. FITZSIMMONS, 1625 Monadnock Block, Chicago, Ill.

FOR SALE—Blue Stone Quarry, located Summit, N. Y., 37 acres; also steam drill in good condition-separate or together; price low. For particulars address T. H. MAGILL, Troy, N. Y.

FOR SALE CHEAP—One Ingersoll 3½ F. Drill, mounted on quarry bar for channeling. Little used and in good running order with some steels; $200. Also, one 50 H. P. Tubular Boiler, with Blake steam feed pump; in good condition, $200. Address NAPERVILLE STONE CO.

FOR SALE—The present owner of the Dix Island Granite Quarries will sell at a reasonable price or will form a partnership with a practical quarry owner on a fair basis for the joint operation of both quarries. The stone from the Dix Island Quarries has been used in the Treasury Building in Washington and the New York and Philadelphia post offices, and is now being used by the present owner on the Metropolitan Museum of Art, New York City, the architect accepting it in preference to all other granite submitted. Address CULLEN & DWYER, 107th and 108th streets and First avenue, New York.

FOR SALE.

Fourteen small Standard gauge trucks.
One 8x12 eleven ton Saddle Tank Switching Locomotive in first-class order.
Railway equipment of all kinds.

NEW JERSEY CAR AND EQUIPMENT CO.,
Lake View, N. J.

FOR SALE.

A LARGE SOAPSTONE DEPOSIT.

Massive formation, free from impurities. Slabs, tablets, blocks of any size can be taken out. Cheaply mined. Convenient to R. R. Reasonable price. Also a mammoth deposit of a superior, dark colored building stone. Better than granite. Address

L. W. TULLEYS, Council Bluffs, Iowa.

STONE PLANT FOR SALE.

We offer for sale our stone plant, now located at Ft. Wayne, Ind., consisting of header, one double and two single planers, four gang and one rip saw, overhead traveller, 55 feet span, 125 H.P. boiler, heater, 14x24 in. boiler, shafting, tools, etc. This is one of the most complete stone working plants in America. We will sell entire or in part. JAMES STEWART & CO.
Contractors and Engineers,
Commercial Bldg., St. Louss, Mo.

D. W. Pratt

MACHINERY, Engines, Boilers, Rock Drills, Stone Saws, Air Compressors, Steam Pumps, Pulsometers Hoisting Engines, Cableways, etc. Send for Special Catalogue. 211 Lucas Ave., St Louis, Mo.

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ON THE BELT RY. OF CHICAGO.
Address B. THOMAS, Pres. & Gen. Mgr.,
Dearborn Station, Chicago.

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For Sale—
Cheap for Cash.

Hoisting Engines, Air Compressors, Rock Drills, Rock Crushers, Dump Cars, Channeling Machines, Steam Pumps, Steam Shovels, Light Locomotives, etc., all in good condition.

WILLIS SHAW,
616 New York Life Building, CHICAGO.

Antique Cipollino Marble, of the finest quality, from the recently rediscovered old Quarries near Carystus, Eubœa, Greece, at the price of modern Swiss.

Farmer & Brindley, London, S. E., England.
Proprietors of Quarries.

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The Best and Cheapest Abrasive for

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Hawley's Patent Sand Feed

Is used by all the leading firms—saws faster and better than any other sand-feed. More gangs using our feed than any other. Easily kept in order. Also many gangs working satisfactorily, using crushed steel. Can give best of references. Orders solicited.

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The Joyce-Cridland Co.

Dayton, O.

Manufacturers of

Patent Lever, Compound Lever, Screw and Hydraulic

JACKS

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Illustrated catalogue free.

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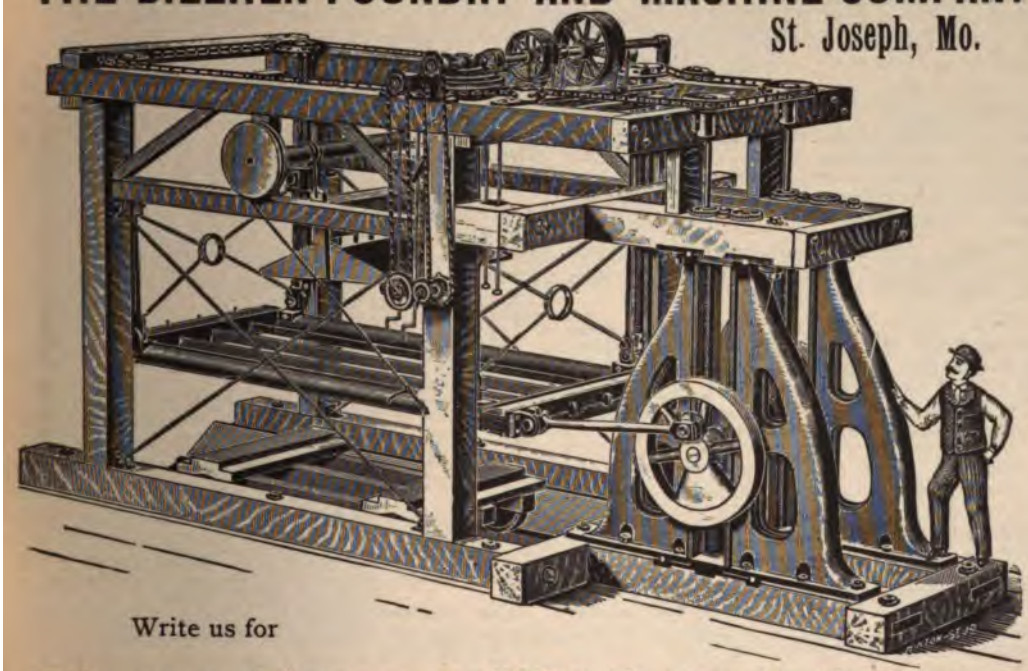
St. Joseph, Mo.



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Stone Saw-Mill Machinery

Notes from Quarry and Shop

Chas City, Va.—It is stated that New Jersey parties will mine kaolin, feldspar and flint rock near Chase City and erect a manufactory to utilize the product.

Arthur G. Stubbs, of Cape May Point, N. J., is interested in the Stubbs Mining & Manufacturing Co., formed to quarry stone, with $100,000 captital stock. Its headquarters will be at 211½ Market street, Camden, N. J.

Palestine, Tex.—William Nance will establish marble and granite yards.

Pittsburg, Pa.—Deposit of fine marble said to have been discovered near Scottdale, Pa., on property of H. C. Frick Coke Co., of this city. If it proves up all that is expected Frick company will develop on large scale.

John Henry Hull has been appointed receiver for the Consolidated Pneumatic Tool Company, of New York and Philadelphia, by Judge Daly, of the New York supreme court, on the application of Horace D. Grove, to whom a judgment obtained against the company on June 20, by John Evans, was assigned. The original amount of the judgment was $13,548, which was reduced by payments to $11,198.

Bedford, Ind.—Robert F. McKinley was appointed receiver of the Sterling Stone Co. by Judge Martin, and his bond fixed at $10,000.

Alfred Bailey, Jr. ,and Peter Mortensen have filed on the stone quarries on the north side of Pigeon Hollow, about three miles northeast of Ephraim, Mich. These quarries contain Sanpete county's celebrated oolite, regarded by many as the finest building stone in the state.

The Cobleskill, N. Y., Quarry company has filed a certificate of an increase of its capital from $30,000 to $80,000.

Adam Hannah, a prominent monument and marble dealer of San Mateo county, Cal., has filed a petition of bankruptcy in the United States district court. The liabilities are $11,284.03 and the assets, consisting largely of unpaid accounts, $3,045.85.

John W. Hicks, colored, has brought suit in the superior court at Wilmington, Del., to recover $20,000 damages from the Brandywine Granite Company for injuries received by rock falling on him.

The Manhattan Concrete Company of 156 Fifth avenue, New York, has made an assignment to Henry L. Fridenberg. The assignment was precipitated by liens against the concern and an execution for $836 in favor of the Standard Silica Cement Company. The sheriff levied on the office furniture. The company was incorporated on Dec. 17, 1895, with a capital stock of $50,000 to lay concrete floors, foundations, etc. The original name of the company was the Aberthaw Construction Company, and the name was changed to the present style two years ago. The liabilities are reported at $60,000. It is stated that the assets will not exceed $25,000 if contract moneys liened shall prove to be lawfully owing to creditors. Many, if not all, of the contracts of the company have been liened.

West Chester, Pa.—The case of the Avondale Marble Company, of this county, which has attracted much attention, came to an end when the court handed down an opinion refusing the application of the stockholders for a receiver. The case was a fight between the stockholders and the board of directors, and the latter won a big victory by the ruling of the court. The stockholders will carry the case to the supreme court. Sheriff Hayes, of Chester county, on Dec. 22 disposed of the plant of the Avondale Marble Company. The property sold as follows: Tract No. 1, 146 acres in London Grove, sold for debt of $499, held by Edwin Hall & Co., and $1174.62, by the National Bank of Kennett Square; the improvements consist of a stone dwelling, good barn and about fifteen tenement houses. Tract No. 2, containing 25 acres 1 rood and 16 perches, in Upper Oxford, sold for $40,600, to Alfred P. Reid, attorney for Brown, Shaw & Tinsman, of Williamsport. This case held the courts the greater part of two weeks, when Judge Hemphill decided to refuse receivers and sell the property at sheriff's sale.

Sioux City, Ia.—Over the grave of Sergeant Charles Floyd a $10,000 monument is soon to be erected. A bill for the necessary appropriation has been introduced in the lower house of congress and every indication is in favor of its passage.

Chattanooga, Tenn.—General A. P. Stewart has withdrawn his objections to the erection by New York state of an $80,000 peace monument at Point Lookout, and the handsome shaft will be erected as proposed. It will be 100 feet high, profusely decorated and handsomely carved.

New York parties and Frank R. Hewitt, of Hewitt, N. C., will develop a talc property near Tomatla, N. C., and a kaolin property near Almond.

The Monitor Lime Manufacturing Company, just incorporated with a capital stock of $20,000, will remodel its works at Texas, Md. The plant will be remodeled to an improved system of burning lime, and eventu-

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have been made and sold by this Company carries with it the assurance of long and successful experience.

500 at the Anaconda Mines, Butte, Mont.
80 at the Homestake, Lead, South Dakota.
14 by Thomas A. Edison, Edison, N. J.

THE "NEW INGERSOLL"

is the embodiment of all that there is good in Rock Drills. Its popularity increases each day

L. L. Manning & Son, Plainfield, N. J. use a Class "E" Air Compressor tacked up on the wall for driving pneumatic tools for lettering on marble and granite. It is a convenient machine for this and similar work.

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QUARRY ..BARS..

Rock Drill used to bore holes in granite columns, Albany State House, Albany, New York.

CATALOGUE No. 41,
ROCK DRILLS Mines, Quarries, Tunnels, Contract Work, Good Roads,

CATALOGUE No. 32,
AIR COMPRESSORS 12 Standard Types and many Special Patterns.

CATALOGUE No. 72,
POHLÉ AIR LIFT PUMP Water Works, Railroads.

Factories, Irrigation, Etc.

THE INGERSOLL-SERGEANT DRILL CO.,

HAVEMEYER-BUILDING, NEW YORK.

ally will be equipped with a grinding plant to prepare lime for glass works, truckers and farmers, which will employ 25 men, with a daily capacity of 1,000 to 1,500 bushels.

It is announced that a New York syndicate, believed to be headed by Richard Croker and John C. Sheehan, was negotiating for an extensive tract of land at South Biddeford, Me., on which it is proposed to erect a large granite quarrying plant.

Milwaukee, Wis.—A new company called the Menomonee Falls Lannon Stone Company has been organized by Messrs. Lindsay and Herman, which has purchased the extensive quarries and property of the Menomonee Falls Quarry company. The Menomonee Falls Quarry company was owned by Mr. Smith, Mr. Hadfield and Mr. Herman. The offices of this cocmpany will be located in Milwaukee.

It is said that the representatives of the Chicago capitalists who lately visited McKees Rocks, Pa., and viewed the Graham property have recommended its purchase. The purpose is to erect a plant for the manufacture of roofing material and cement.

Mr. R. A. Gledhill has engaged in the monumental business at Albion, Ill., styling his establishment the Enterprise Marble Works. This gives Albion three houses which deal in or manufacture marble and granite tombstones.

Wauseon, O.—Rohr Brothers have opened up a store where they will deal in monuments and building stone of all kinds.

John Tyrie, of Cockeysville, Md., has put in a plant for marble working and will add a 34-horse power boiler.

J. B. Thomas has embarked in the marble and granite business in Monroe City, Mo.

Two new limestone quarries have been opened on the farm of J. D. Hicks & Son, near Williamsburg, Pa., by the Clover Creek Limestone company. C. M. Cook of Youngstown, O., manager of the company, has made arrangements for the railroad siding and placing machinery needed for operation. The same company operates two quarries along Clover Creek.

Omaha, Neb.—The Metz Bros. Brewing Co. will erect a new plant. New machinery will be purchased and an ice plant established. Estimated cost $225,000.

St. Louis, Mo.—The Second Presbyterian Society will soon let contracts for a $10,000 church, to be completed before the fall of 1899.

St. Louis, Mo.—The Tyler Place Presbyterian Society is taking steps towards building a $13,000 church. Rev. John B. Brandt, pastor.

Brownsville, Tenn.—The M. E. Society South has decided to build a $10,000 church. Plans not prepared. Rev. T. J. Newell, pastor.

Arkadelphia, Ark.—Plans are being prepared by Chas. L. Thompson for a $30,000 jail to be erected in Clark county. Jon. J. H. Crawford, commissioner.

St. Paul, Minn.—Herman Kretz & Co. are preparing plans for a 72x130 Catholic church to be erected in the spring.

Lincoln, Kans.—The Lincoln county court house burned. Loss $12,000 with insurance at $6,000.

Oconomowoc, Wis.—A. S. Partridge, who for quite a few years has conducted the marble and granite works in this city and at Elkhorn, has disposed of his Elkhorn plant and sold a half interest in his Oconomowoc works to Thomas Handford, the business to be conducted under the firm name of Partridge & Handford.

Syracuse, N. Y.—Charles Hughes, of Hughes Sons & Bangs, died Dec. 18.

The Currier Stone company, at Pierre, S. D., with a capital of $200,000. Incorporators, F. W. Lowery, E. L. O. Apel and E. L. Squire.

December 9 David Scott, the well known marble and granite dealer at Pontiac, Mich., died, aged 67 years. Mr. Scott was formerly located in Dunkirk, New York, but came to Pontiac a number of years ago. Mr. Scott has been prominently connected with the Masonic Fraternity being an active member in the Knights Templars. He leaves a widow.

The Alexander McDonald Co., recently incorporated in New Jersey, will manufacture monuments, with $25,000 capital stock. A. R. Baxter, of Trenton, N. J. (862 Centre street, may be addressed.

Henry Cowell Lime and Cement Company. Principal place of business, San Francisco. Directors.—Henry Cowell, S. H. Cowell, Isabella M. Cowell, Helen E. Cowell, and W. H. George, all of San Francisco. Capital stock $500,000, all subscribed.

Pueblo, Colo.—The Madison Stone Company, with the following directors: J. F. McParlin, A. F. Cole, A. T. Fisher. The capital stock is $10,000. The new company will operate in the counties of Pueblo, El Paso and Fremont, with offices at Pueblo, Colorado Springs and Canon City.

The San Luis Obispo, Cal., Bituminous Rock Company, with a capital stock of $1,000,000, all of which has been subscribed. Following are the names of the subscribers and the amounts subscribed: G. B. Nichols, $166,700; F. Adams, $166,700; Alfred Walker, $166,700; J. A. Fairchild, $500; J. F. Crank, $62,500; I. W. Hellman, $62,500; W. J. Brodrick, $62,500; G. A. Dobinson, $166,200; L. M. Kords, $83,300, and E. F. Spence, $62,500.

Bronx Granite Company of New York City; capital stock, $10,000. Directors F. H. E. Zimmerman and Charles Zimmerman, Jr., of New York City, and J. P. Powers, of Elizabeth, N. J.

Sullivan Quarry Bars
Sullivan Gadders
Sullivan Rock Drills.

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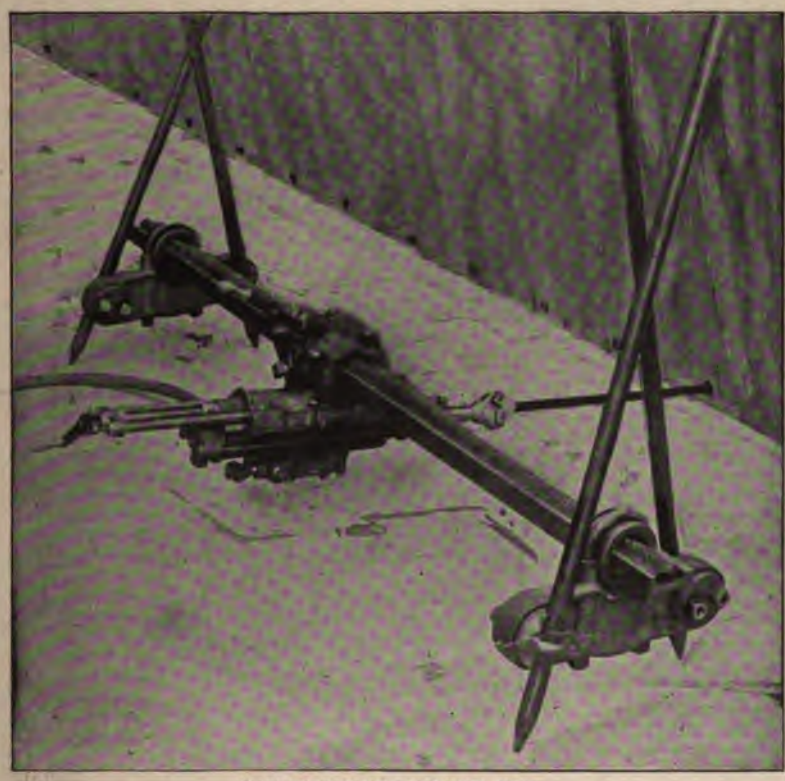

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Contractors for

Prospecting Quarry Lands with Core Drills.

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339 Fifth Ave., PITTSBURGH, PA. 332 Seventeenth St., DENVER, COL.

Please mention STONE when writing to advertisers.

The Cleveland Stone Company's packing house at Grindstone City, Mich., was damaged $20,000 by fire, Dec. 7.

James G. Lindsey, superintendent of the Newark Lime and Cement Manufacturing Company, died at his home, Kingston, N. Y., aged 80 years. He was an able geologist, and an authority on the cement-bearing rocks of New York.

Hastings, Mich.—Asbury Black, died at the age of 75. He conducted a granite and marble business at Coldwater for twenty-five years before coming to this place in 1881, since which time he had built up one of the best known businesses in this line in the state.

Marquette, Mich.—William Burt, one of the earliest pioneers of the upper peninsula. In 1856, as United States deputy surveyor, he surveyed the land at the head of Lake Superior and among other locations the site of Duluth. He had resided in this region since 1846 and for the past fifty years had been engaged in the mining, milling and quarrying industries. He was 73 years old.

Joliet, Ill.—James Bruce, the pioneer stone quarry man of this section, died Dec. 14. He was 75 years old. He leaves five children and a large estate.

Oren Sherman, a resident of Chicago since 1836, and for many years one of the city's most prominent business men. In 1859 he went into the stone and lime business with his brother, Alson S., at Lemont and Bridgeport, subsequently organizing the Illinois Stone and Lime Company, this firm soon afterward becoming the Illinois Stone Company. Mr. Sherman finally established himself in the marble and granite business at the head of a stock company, which continued until it was destroyed by the great fire of 1871. In 1872 he erected a large manufactory in Wabash avanue, and with his sons, L. E. and Frederick J., organized the Chicago Marble Manufacturing Company. This firm dissolved in 1877 and was succeeded by the present firm of Sherman & Flavin.

Asheville, N. C.—William Thompson, of the granite firm of John Thompson & Son of Quincy, Mass., died here Dec. 17. He was born in Scotland in 1842, but lived in Quincy nearly all his life.

The Melvin granite quarries, near Hallowell, Me., have been bought from George F. Whitten of Lewiston by C. E. Tayntor & Co., of New York. The property consists of sixty acres of land, and the new owners say they expect to make it one of the largest quarrying plants in the country.

Kankakee, Ill.—Brayton & Kerr have taken another six years' lease upon the West side stone quarry of W. W. Bird, which they have operated with success. It is their intention to place in operation a steam derrick and a pumping plant of twice the capacity of that now employed. Next year it has been planned to deepen the quarry five feet, which will give the quarrymen an abundance of flagging, which they have been able to produce in limited quantities only, hitherto.

Charles Burkett has bought a half interest in the marble and granite business with Charles Strong at Belvidere, Ill.

Independence, O.—Levi Wolfe closed a bargain for two acres of ground for quarry land at the modest price of $1,000 per acre. There is 60 feet of solid rock, 15 feet of stripping.

Eau Claire, Wis.—Geo. F. Penn has purchased the marble works formerly owned by the late Robert Wilkie.

Aurora, Ill.—There has been another change at the Broadway stone quarry and Cal Riddle is now sole proprietor. His late partner was G. F. Doetchman.

The Freeport, Me., stone quarry, formerly the property of E. B. Mallette, was sold at auction to Wm. L. Noyes, of Pownel for $2,000.

Shea & McGeary, granite and marble dealers of Findlay, O., hase dissolved partnership. James Shea having purchased the interest of R. A. McGeary, will conduct the business at the same place, and will put in a large stock of the latest designs..

The question of building a new court house at Dixon, Ill., will be brought up at one of the meetings of the board of supervisors next year for things are getting in such shape that something must be done to protect the documents of the country.

Toledo, O.—The St. Anna's Catholic Society will build a church in the spring.

Sheffield, Tenn.—Gen. Wheeler has introduced a bill in Congress providing for the building of a bridge across the Tennessee river at this place.

Smithville, Tex.—The Indiana Bridge Co., of Indianapolis, Ind., has received the contract to construct a $23,500 bridge across the Colorado river at this place.

Jackson, Miss.—The city will construct a two-span "Melan" bridge 100 feet wide, also will build a smaller rolled girder bridge. Bonds for $20,000 will be issued to pay for the work projected. Walter G. Kirkpatrick, city engineer, D. P. Porter, city clerk.

Lexington, Mo.—A bill has been introduced by ex-Senator Cockrell to provide for the construction of a highway bridge over the Missouri river at this place.

THE WARDWELL
Steam Stone Channeling AND Quarrying Machine

The original and first Stone-Channeling machine ever invented. Will pay for itself in a short time in the reduced cost of getting out stone. *Has no equal for efficiency and economy of operation.*

Pronounced by Those Who Have Used It the Best Machine for the Purpose in the World.

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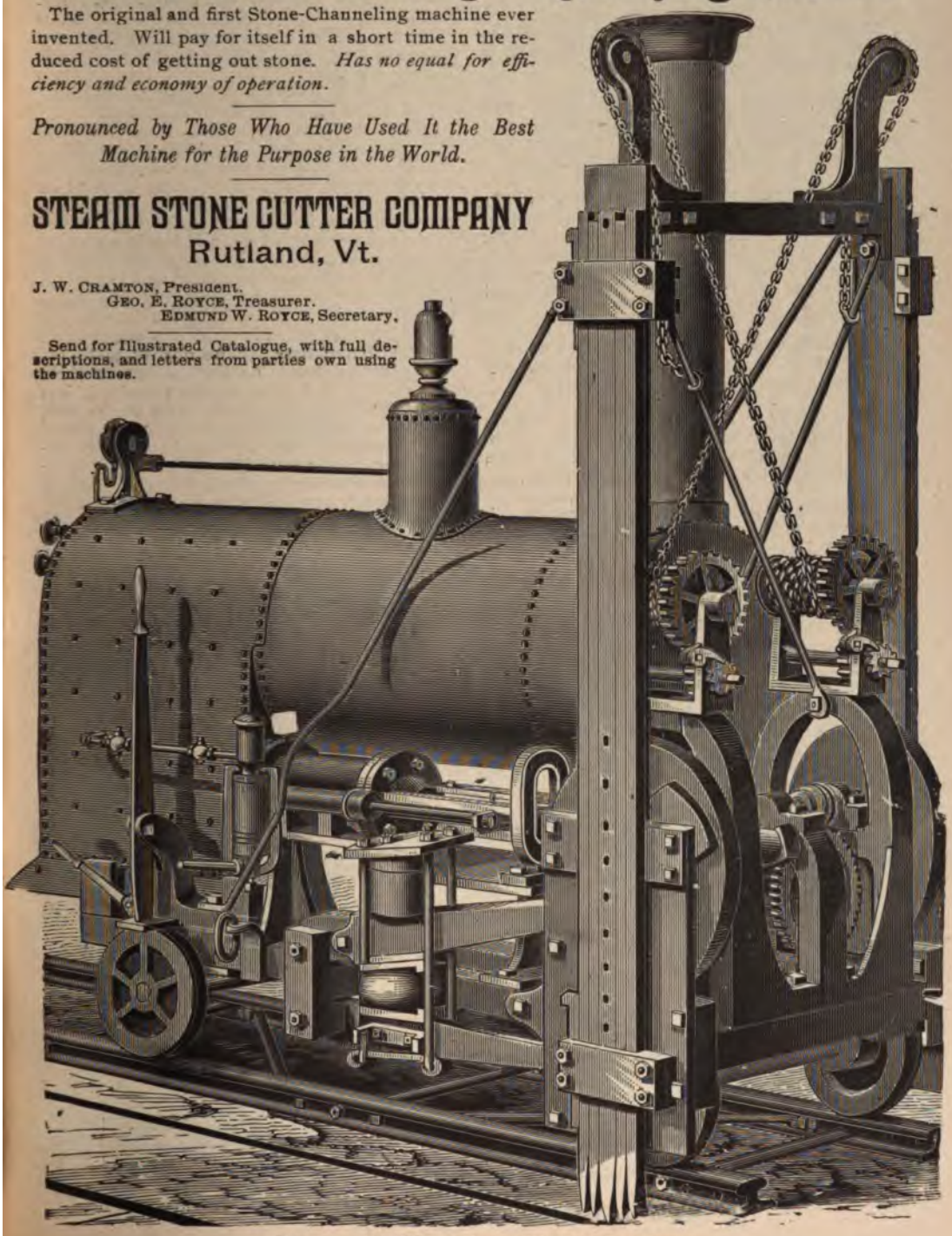

Chelsea, Ia.—A bridge over the Iowa river will be built at this place soon.

Carrollton, Ky.—The Carroll fiscal court has appropriated $20,000 towards the building of the bridge over the Kentucky river at this place.

Keokuk, Ia.—The question of a high bridge across the Mississippi river at this point is again being agitated.

Quincy, Ill.—The Burlington Road will make considerable improvements to cost about $1,000,000 at this place. They include a new bridge across the Mississippi river.

Indianapolis, Ind.—The arrangements are nearly completed for the organization of a new company for the purpose of building a bridge across the Ohio river between Ghen and Vevay, Ind., connecting the Kentucky and Indiana systems of the Black Diamond railway.

Pittsburg, Pa.—There are rumors that a bridge is to be built across the Allegheny river at a point opposite Aspinwall.

K. B. Harvey, Punta Gorda, Fla., wants to buy cable or wire-rope conveying equipment for handling lighters back and forth from deep water to warehouse on shore.

Lime-kilns.—R. P. Pearson, Parsons, W. Va., wants information and estimates on ironclad lime-kilns.

Relic of the Stone Age.

About a mile east of the Dumbarton rock, in the Firth of Clyde, a dwelling on piles or crannog, has been discovered below high water mark, some 50 yards from low water mark. It is 184 feet in circumference, the outer circle of piles being of oak wood, sharpened with stone axes. The transverse beams and floor are of oak, willow, birch, elder and branches of fir, birch and hazel, and bracken (ferns), moss and chips. In the refuse heaps outside the crannog wre found the bones of stags, cows, sheep, signs of fire, many firestones, and a whitestone or hone. Near-by was a canoe 35 feet long by four feet wide, hololwed from single trunk of oak. The crannog is the first yet found in an estuary, and it evidently dates from the stone age; therefore, it seems earlier than others yet found in the British isles.

They Had No Derricks

The method of erecting Egyptian obelisks has long puzzled the student of Egyptian antiquities, and the numerous documents and wall-pictures found don ot explain it. In a late issue of "Construction Moderne," Mr. J. C. Kruseman suggests a possible method of handling blocks of stone weighing as much as 1,000 tons, and sometimes 131 feet high and 10 feet square at the base. These blocks were also placed on pedesals considerably raised above the actual level of the soil.

Mr. Kruseman finds that these obelisks were generally placed in front of pylons or temples. He believes that the Egyptians first built a slightly inclined causeway of sand or other material, equal in height at one end to the obelisk to be erected, ending at the end in a strong wooden crib, and leaving a space between the crib and the temple for the obelisk. The base was then built and the space between the temple and the crib was about half filled with sand, and on the face of the crib a strong inclined chute was constructed leading to the base. The obelisk was then rolled up the incline on hard wooden rollers, and, with tackl leading ot the temple, it was then allowed to tilt over the front of the crib, falling into the sand and guided by the chute. By slowly and carefuly digging away the sand and hauling on the top of the obelisk it would thus be gradually sunk, until it would finally rest on its base.

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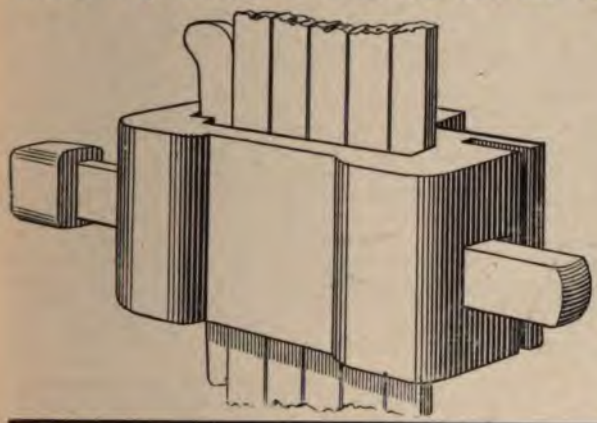

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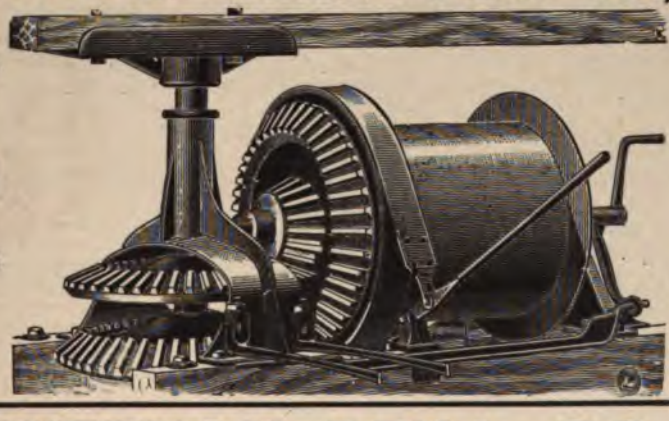

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BOOKS AND PERIODICALS

OLD GLORY SERIES, by Edward Stratemeyer; Cloth Ilustrated. Lee & Shepard, Publishers; Boston.

The career of Larry Russell, as recorded in "Under Dewey at Manila," has been the hit of the season among juveniles, the publishers having been unable to keep pace with their orders, and now comes a companion volume which bids fair to rival its predecessor in popularity. All who have followed the fortunes of Larry will be interested equally in the adventures of Ben, his older brother, and his friend, Gilbert Pennington, and the many exciting scenes through which they passed during their service in the army. Ben enlisted in a New York volunteer regiment, while Gilbert joined Colonel Roosevelt's famous Rough Riders, and both were among those selected for active service in Cuba. Their life in camp, the voyage across from Tampa, the landing at Baiquiri, the capture of El Caney, the charge at San Juan hill are all vividly described. While the story is full of life and incident, the historical portion has not been neglected by the author, who has verified his facts from the official reports of the commanding officers, supplementing these with narrations from the personal experiences of men who took part in the Cuban campaign. The book is good healthy reading, filled with patriotism and alive with stirring incident.

STORIES OF THE AMERICAN REVOLUTION. Second series; By Everett L. Tomlincson; Cloth Illustrated. [Price $1.25.]

These interesting stories of our forefathers are not the hackneyed ones which have been used in the popular histories for generations, but they are the result of Dr. Tomlinson's research among the archives of revolutionary times. Like those in the preceding volume, the basis of each story is historically correct, and told in the author's attractive style they are doubly interesting to the young reader. Dr .Tomlinson says, "There is no deep love of country without a thorough appreciation of what it has cost to found and develop the land we love," and this volume is an endeavor to show something of the price our fathers paid that we might have a country. The stories are not only of value to the household, but will make very attractive supplementary reading for schools. [Price, $1.00.]

American Cements, by Uriah Cummings Published by Rogers & Manson, Boston. Price $3. Orders solicited by Stone.

No subject is more interesting to engineers, contractors and builders than one dealing with Limes, Mortars and Cements. America is the greatest producer of rock cement, and the champion defender of its quality is the author of this treatise. Mr. Cummings' purpose in writing this book was to set forth the claims and merits of hydraulic cements, or natural cements, as they are known in contradistinction to the artificial products, denominated Portland cements. That he has made a thorough and convincing work of it none will, or can, dispute, who will read him thoughtfully. It is sufficient for our reference to this treatise to simply call attention to the fact, that the author is exhaustive in both the theoretical and practical consideration of his subject. We commend the work as authoritative in its classification, its analysis and its practical information. Everyone interested in the subject of cement of whatever quality, must possess this work to be the best informed regarding it.

The complete novel in the January issue of Lippincott's is "The Mystery of Mr. Cain," by Miss Lafayette McLaws, daughter of the Confederate general of that name. The scene is in Georgia, and the plot is so uncommon that to reveal it would be unfair to the reader.

The industrial evolution of mankind, chiefly through which civilization has reached its present stage, is dsecribed by James Collier in an interesting article in Appletons' Popular Science Monthly for January. The gradual growth from the primitive nomad to the modern industrialist is carefully followed out in detail.

"A great American Sculptor" is the title of an article in the American Monthly Review of Reviews for January, in which Miss Laura Carroll Dennis describes the work and career of that rising young genius, Mr. George Grey Barnard. The article is illustrated with photographs taken especially for the Review.

An unique, and withal very interesting booklet is "Short Sermons on Stone," delivered in time for a holiday greeting to its friends, by the Cleveland Stone Co. This odd and excellent bit of sense and sentiment cannot be described in a way to make a clear mental picture of its peculiar character—one must see it to comprehend its unfolding of art ni advertising in printing and in typography. The editorial genius who has "sermonized" so wisely, so tritely, and so eloquently blazens forth not a whit less remarkably in the work shown, than does the freehand artist, the photographer, the engraver and the printer, who collectively have embellished this really superb production.

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Miscellaneous Slate Items.

The demand for slate continues quite fair at Poultney, Vt., with better prospects for the coming year than for many years past. The action of the syndicate in disbanding had a good effect, in cleaning out the old stock, much of which had been carried altogether too long.

Five large slate quarries at Wind Gap, Pa., will soon be worked again, after a long suspension of operation.

We are informed that negotiations are in progress for an increased development of the slate quarry interests at Rockmart, Ga., and that steps are being taken to increase the capital there invested with a view to increasing the slate plant and greatly enlarging the capacity of the slate quarries. Slate roofing and other slate products will be manufactured, including marbleized slate mantels, blackboards, etc.

It is proposed to establish a large number of agencies of these quarries in all cities south of the Ohio river, also at Chicago, St. Louis, Cincinnati and in the large cities west of Chicago and the southwest. Agents will also be appointed in Europe, and the trade in the south adjacent to the quarries will be energetically pushed.

This inexhaustible and compact body of slate located in northwest Georgia in Polk county, near the town of Rockmart. The quarries are well situated for transportation in any direction, south, north, east or west, or to the seaboard for shipment to Europe. It is said that it is so located that it can control the largest area of purchasing territory of any of the great slate deposits of this country. The splendid climate will enable the quarries to be worked all the year around, while the cheap labor of the south and other advantages will, without doubt, insure success.

On account of the extensive shipments of slates which are taking place local export agents are desirous of adding slate accounts to their representation for local export trade says the N. Y. J'n'l. of Com., but the difficulty met with is that roofing slate is mostly all sold directly abroad by the quarrymen and a very small portion of the busines is found among local export merchants, and if they do receive an order of any consequence where the slate should be bought is usually stated by the purchasers. The extraordinary growth of export business in slates is very noticeable An oportunity for its development was given by the strike in Wales and the prolonged suspension of work which followed. Advantage was taken of this condition by American quarrymen and a foothold abroad has been secured. It is claimed that the finest quality of Welsh slate is better than the American, though quarrymen in this country are not willing to admit this. This quality, however, has only a very limited sale, owing to its high price, and the ordinary grades of roofing slate are very similar to the American slates which are sold at a lower price. So far Great Britain has been the chief customer for American slate, though small quantities have been sent to Germany, France and Denmark. The growth of the trade is shown by the fact that the exports to the United Kingdom in the fiscal year ending June 30th, 1893, amounted to only $1,400, but in 1897 they had jumped to $695,980. Of the total value of $1,370,075 in slate shipped from the United States to all countries in the fiscal years 1898 fully $900,000 went to the United Kingdom. During the next fiscal year it is likely much more slate will be sent to that country, as the port of New York has already shipped there during the four months from July 1st to October 31st nearly $245,000 worh of slate, which compares with $557,099 in the whole fiscal year ending June 30th, 1897. There have also been hsipments from Philadelphia and Baltimore as well as from other minor ports. New York rmains the chief exporting port. The main point now is to retain the trade which the difficulties of the English quarrymen have put in the hands of the Americans. It has been suggested that it would be well to establish a central selling agency in London, with a warehouse where different varieties of American roofing slate could be kept on exhibtion, with sufficient stock to fill orders needed at short notice. To do this would of course require the co-operation of a number of producers, among whom the necessary expense could be divided.

The Grand Central Slate Company, Pen Argyle, Pa., quarried a block the like of which has never been mined at any quarry. The block was taken out of their big bed and measured in the rough 11 feet 6 inches by 4 feet 6 inches and 19 inches in thickness. It was split in two before being hoisted to the landing. Two lengths of blackboards were made out of the block, 5 feet 9 inches by 4 feet, and 5 feet 3 inches by 4 feet respectively, the total production of the block being 110 blackboards, aggregating 2,376 square feet of surface.

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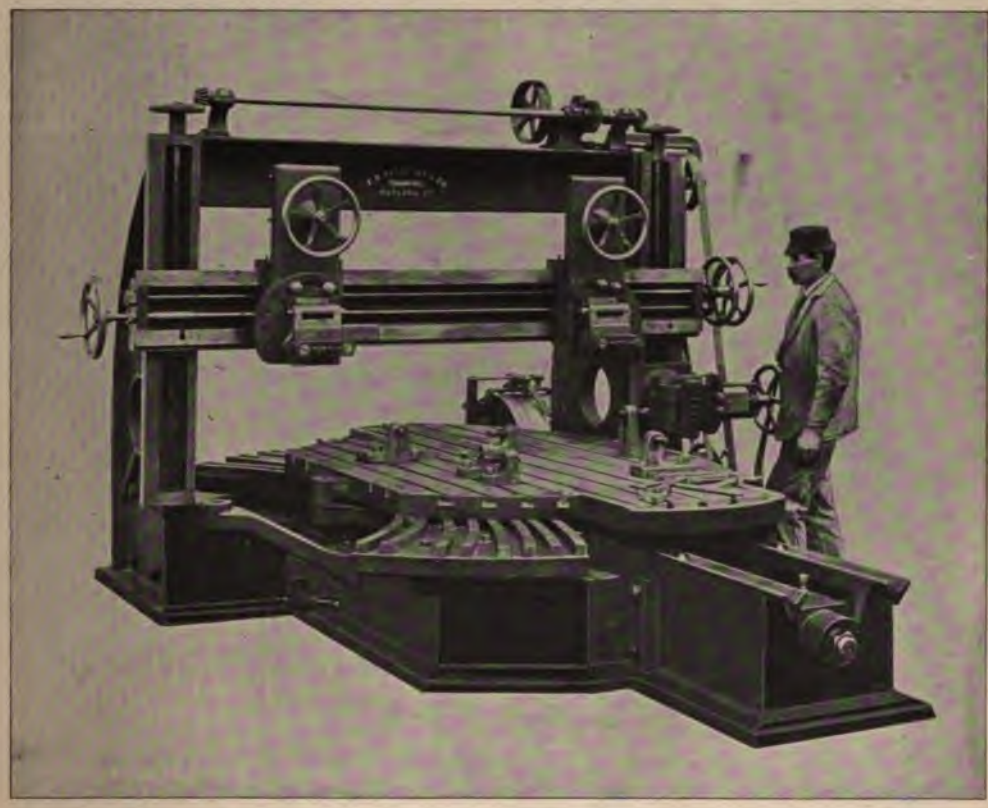

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MARBLE AND GRANITE

Granite Cutters' Demands.

The Granite Cutters' uion has notified the manufacturers of New England that a new bill of prices will be asked for March 1.

The bill contains many changes from the present schedule, chief among which is the demand for an eight hour day. At present the men work nine hours on five days of the hours a week, and five hours Saturday making fifty hours a week.

The men ask that the pay of skilled workmen be not less than 30 cents an hourfi and that all work not specified in the bill shall be cut by the hour. The minimum price now paid is 24c.

A weekly pay day also is asked and in case of overtime work, the workman is to be paid time and a half. Another request is that there shall not be more than two apprentices to every gang of 13 journeymen shall be allowed, and that cutters 55 years old or older, not capable of doing an average day's work, may make their own terms with the employer, subject to the approval of the union.

A strong contest will undoubtedly be waged if a satisfactory settlement is not arrived at. The manufacturers have asked that if it is impossible to arrive at a definite conclusion by March 1, the men will keep at work under the old bill until the details of the new have been amicably adjusted.

Greater New York's Granite and Marble Industries.

The marble trade has assumed large proportions in New York, and this point is now the centre from which manufactured marble is sent all over the country. There are in New York and vicinity some fifteen large concerns which deal extensively in manufactured marble, and which conduct likewise the business of its manufacture. They import large quantities of marble annually from Carrara, Sienna and various Italian cities, and consume a vtst quantity of the American marble, which finds its chief use for building purposes.

The use of white marble for fine buildings has given an impetus to the trade recently, though it has always been an important one. It is estimated that more than 200,000 cubic feet of white marble will be used in this city alone within the next year, and as the local dealers and contractors will supply much that is required elsewhere, the aggregate business done by them will run into the million of dollars. In addition to the marble sold for building purposes, the local firms do an extensive business with the manufacturers of fine monuments. They maintain large works at which employment is given to between two thousand and twenty-five hundred men. Designers, clerks and agents bring the number of persons employed by this industry up to three thousand or more men.

Those who are connected with the trade say that the signs at present point to a more general use of marble for building than has ever before been known.

Although the city proper has developed granite quarry within its bounds, still this industry like nearly all others, is making New York its headquarters. The product of the granite quarry can be roughly divided into three classes—monuments, building and road-making. The finest grade of natural stone is necessary for monument purposes, and, while the quarries from which this material is obtained are located elsewhere, they are represented in headquarters in this city, and conduct both selling and finishing operations from this point.

The total product of finished granite for monument purposes last year is estimated at 5,000,000, and the amount used for road and building purposes will exceed that sum many times. New York is the largest user of building granite in the country, and all the large producers have offices here, sending their salesmen to all parts of the country. Maine, Connecticut, and other States supply New York with its granite, the easy wter transportation making this a natural point for shipment.

The crushing of granite for street purposes is of comparatively recent development, and the product used here is mostly quarried and crushed along the Hudson River. It is this demand that is aiding so materially in the destruction of the Palisades and other historical points further up the Hudson.

The New York dealers are called upon to figure upon all of the largest contracts for granite required. The local demand for granite is exceedingly large at present, and is growing all the time. Various fine offices struetures which have been up in the last few years have served to attract attention to the peculiar beauty of granite for building purposes, and its durability is likewise a feature which commends it.

Its general use is indicative of the substantial character to which modern architecture aspires.—New York Tribune.

The increase in the amount of granite shipped from Hardwick, Vt., goes on steadily from month to month, and there is no better indication of busines than this.

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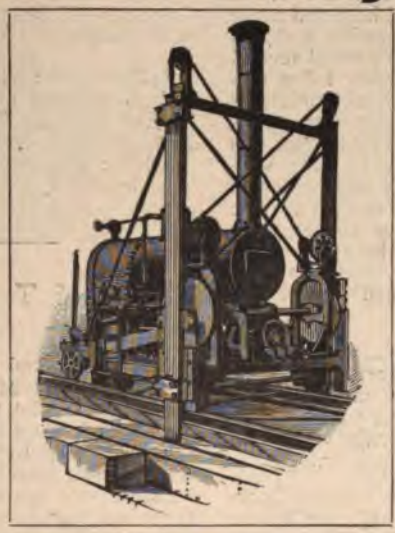

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THE NEW ALBANY M'F'G. CO., - New Albany, Ind.

A Big Deal in Granite.

Hallowell, Me.—A deal has been consummated in Hallowell which will develop another granite business in this city which will be one of the largest in New England if the present plans are carried out. The Melvin quarry property, situated on the western outskirts of the city, has been purchased from George F. Whitten of Lewiston by C. E. Tayntor & Co., of New York. The property consists of 60 acres of land. The quarry itself has been opened for many years, but has been but partialy devoloped. The quality of the granite from this quarry is excellent. George B. Lord, who has been connected with the Hallowell granite industry for several years, is a party to the deal and will be the superintendent of the Hallowell end of the business. No exact figures have been made public to denote the magnitude of the operation, but it is confidently asserted that it will be on a large scale.

Denison, Tex.—One of the best granite finds in the Indian Territory has bene made on the Ward place, eight miles north of Tishomingo. A fine quary of granite has been discovered which compares favorably with the granite quarried at Quincy, Mass. A test of the stone has been made by acid, and all its qualities are reported as good as the Quincy product. This is one of the highest-priced granites in America, and it is believed that when the Tishomingo granite is put on the market it will have a ready sale and the demand for it be strong.

A. B. Niles recently returned from the Wallowa marble fields, where he spent about 10 days investigating the merits of the marble deposits found near Joseph, says the Walla Walla Statesman. He engaged help and made careful observations at several points and was so favorabily impressed that he located several claims. He also located a granite ledge discovered by Mr. Vinson a few weeks previous, in the vicinity of the marble deposits. This granite of gray and salt and pepper color has every appearance of being equal to the Vermont granite of like color. It will be tested both for texture and working qualities. The citizens of Joseph are anxious to see their marble and granite placed on the market, and Niles & Vinson, of this city, feel confident that their firm will be justified in opening the quarries.

The granite cutters of Georgia, who seceded from the national in 1894 and formed a southern union, have returned to the national body, and thereby been able to secure agreements in three granite centers of Georgia, which call for the employment of union men only.

The granite industry of Elbert county, Georgia will now take on new life, says the Macon Telegraph. Blood from Maine has mixed with that from Georgia and we predict a wave of prosperity in the stone of Elbert never before realized. Elbert has as fine granite as can be found in the country, and already finds ready sale for it. Under the new regime it will be more popular than ever, and will be pushed into every state in the union.

The granite manufacturrs of Quincy and other places have had considerable trouble because of the rough handlin that boxed granite received in transit on th cars and in delivery to the customer. In many cases the boxing has been smashed and corners knockeu off the granite when delivered, which means a claim for damages, and in some cases a lawsuit before th manufacturer gets his money. To try and remedy this evil the Quincy manufacturers have appointed a committee to meet a like committee from the Barre manufacturers, to try and remedy this evil.

Milford, Mass.—Ross Bros.' new quarries on Cedar street promise to be easily worked, the stone rising in huge walls from 75 to 100 feet above the level. The firm has purchased a strip of land running to the border of Echo Lake, and claim there is more stone therein than in any other quarry in Milford, and nearly as much, if not more than in all the others combined. The stone is of the pink shade peculiar to Milford granite and is regarded as a great find.

The Metallic Monument Co., of Toronto, Ont., was organized and incorporated in May, 1896, with an authorized capital of $45,000. Whatever was the reason, whether because people preferred granite and other stony substances for memorial purposes, or what, it appears too true that the metallic headstone business has been a failure and the company is in financial trouble. Recently, suits were instituted by creditors, judgments obtained, and now the bailiff is in possession.

A strata of fine marble has been discovered near Nettleton, Mo.

Sullivan, Me., shippd during the past season 38,350 tons of granite, mostly in curbing and paving. This is the smallest season's shipment for several years, but prospects are good for next year. Franklin and Sullivan have loaded 153 vessels during the past season.

Liability of Termination of Indefinite Contract.

Where one had been engaged in furnishing labor and materials and in superintending work in the repairing and erection of buildings for another, under an arrangement for no definite period in the future, nor for the repair or erection of any particular buildings, he was entitled to maintain an action for what was due him, immediately on having elected to terminate such arrangement. —Quin vs. Bay State Dist. Co., Mass., 50 N. E. Rep., 637.

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NEW YORK OFFICE:—38 Dey St.

MACHINERY AND SUPPLIES

A Prospering Concern.

A firm that enjoyed a good share of prosperity last year is the Dobbie Foundry & Machine Company of Niagara Falls, N. Y.

The plant of the Dobbie Company is practically a brand new one, the first plant, which was about half the size of the present one, having been destroyed by fire in August, 1896. Almost immediately after the fire the present company went to work upon the plans for a new and much larger plant and in a remarkably short time it was built and being operated, and the business has been growing better ever since. The receipts of each year show a marked increase over the receipts of the previous one and the year 1898 was a record-breaker.

In fact business in the foundry department has been so brisk that it has been found necessary to increase the plant, and work was begun on a large brick addition a short time ago which is now being occupied. It will afford the company an additional moulding floor space of 2,000 square feet. The new addition is 40 feet wide and 50 feet long and is built entirely of brick and iron, like the rest of the plant. It is one story high and is built on the rear of the main foundry building. The buildings of the plant of this company now cover about an acre and a half and they are all very substantial structures.

The company has a contract with the Niagara Power Company for 75 electrical horse power, which is sufficient to run the machines in the machine shop.

While the Dobbie Foundry & Machine Company does a great deal of local work they also do a fine outside business. Considerable of their work, such as quarrymen's and contractor's machinery, is shipped abroad. Particularly during the past year the foreign orders have been coming in. In one instance an order was received for two large cranes to be used in the construction work of the great Siberian Railway, that is being built by the Russian Government. Shipments have also been made during the year to Belgium, South America and Mexico and considerable work has been done for the United States Government for improvements in the navy yards and for the construction of coast defenses.

Sufficient orders are now on file with the company to keep the shops busy for the next three months.

One of the most interesting contracts ever received by the Dobbie Company was for the immense big columns for the wheel pit of the Niagara Falls Power Company. These columns weighed over six tons each and were single castings. They were placed in the wheel pit as stays at the time it was discovered that the walls of the wheel pit were coming together.

This company has enjoyed the general prosperity of the steel rolling mills all over the conntry during the past year. Besides the wide range of work in quarrying and contractors' machinery, the company makes a specialty of heavy blacksmith work, having recently installed several large steam hammers.

The officers of the company are John Dobbie, president and treasurer; A. J. Dobbie, secretary; John T. Horton, member; A. S. M. E. superintendent; A. T. Throop, superintendent shop work.

The company does most of its business in contractors' supplies through the New York office, located with Harold C. Dayton & Co., at No. 38 Dey Street.

The Murray Iron Works.

A good engine is the essential thing in stone-working plants. It never pays to experiment with a cheap engine or boiler. True economy implies the best made and simplest driver to be had. That's the kind produced by the Murray Iron Works Co., of Burlington, Iowa, whom we have the pleasure of introducing to the readers of Stone in this issue. Get their catalogue of engines and boilers.

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The Handiest, Simplest, and Most Efficient Steam Pump for General Mining, Quarrying, Railroad, Irrigating, Drainage, Coal-washing, Tank-filling, Paper Mill, Sewer and Bridge Contractors' Purposes, etc., etc.
Muddy or gritty liquids handled without injury to the Pump.

PULSOMETER STEAM PUMP CO.,
135 Greenwich St., - NEW YORK.

CORRESPONDENCE.

Sault Ste. Marie, Mich.

No outdoor work in the building line at present, and there will be nothing done here till next spring. I think there will be plenty of work in the building line by that time.

Wm. Chandler, President of the Edison-Sault-Electric Co., has been endeavoring for some time to interest capital in the further development of the water power on the banks of the rapids which generates the electricity to light the city and revolve a number of wheels of industry. Mr. Chandler returned recently from the east where he has been negotiating with capitalists' and it is understood that plans are rapidly beinb formulated which will result very soon in the development of more than 30,000 horse power—almost as much as wil be developed by the Lake Superior Power Co.

Engineer M. G. Barnes was employed last summer in making the plans for the big enterprise and it is said that they offer rare inducements to capital as it is shown conclusively that this power can be developed at a very small cost per horse power.

There does not seem to be a consistent reason why this second contemplated large water power enterprise should not materialize as it certainly offers greater inducements to investors than the big canal now in process of construction.

Mansfield, Ohio.

The stone trade in Mansfield is quiet just now.

Stone work on the new wing of the Reformatory is shut down for the winter months. But it is expected to open up early in the spring.

The quarries in this vicinity have a small force of men employed stripping, getting ready for the spring trade.

There are a few new buildings spoken of but it is not certain at the time of writing that they will be built this summer.

School Board of Lima, O., are going to build a 16-room school building in that city, architect W. R. Brown of Cincinnati with Leach & Leach of Lima associae architects. To be biult of pressed brick with stone trimmings; estimated cost $30,000.

Wooster, O., is to build an electric light plant, brick, stone trimmings, cost $20,000, and three story brick business block, cost $15,000.

Cleveland, Ohio.

This is not the best season of the year for a building craftsman to report about the conditions of trade, as he certainly has no good *news to report.* That is the situation here at present, but there is work ahead for us if we only wait.

But the building trades and citizens of Cleveland have come to regard the promises of the city administration, county commissioners and federal government officials as they do the proverbial pie crust, easily broken. It has been a long day since we were promised a new federal building, and now our representative in Congress assures us that present Congress will appropriate $2,500,000.00 for said building. Even at that we canot expect to see it started until sometime in he next century.

The situation on the municipal building court house and jail, claiming that present quarters are too small and inadequate for the volume of business done there. But the county commissioners are moving like snails even though they have full power in conjunction with three specially appointed commissioners by the court, to proceed and build at once.

The situation in the municipal building (The City Hall) is about the same as in my last report. The administration and city council have locked horns on the "commissioners," so they say. Any old excuse is better than none, so long as it will last them until the spring election.

The Public Library is also a much needed building and the trustees are busily engaged looking up a desirbale site. They claim to have options on ten parcels of land. Possibly if they had less to choose from they would the sooner decide.

The daily papers will soon announce their annual output of magnificent buildings for this city for the coming summer. They usually commence about January 1st and they build on paper more buildings in one month than could be built by twice the number of building craftsmen that live in Cleveland in one year.

Outside of those newspaper buildings there is nothing at present that would warrant my saying that the coming summer will be an exceptionally good one, for the reason that I do not believe that any one of the large jobs I have spoken of will get started until the fall of '99 or spring of 1900, if then. One of the high schools will start as soon as the drawings are finished and contracts let, the other will have to wait some time, possibly until a new site is found for it, there being some objections to the site purchased for it. It is quite possible that the actions of our banking institutions in lowering their rate of interest upon loans from 7 and 8 to 5 per cent will be an incentive to a building boom in this city, with interst on deposits at 3 per cent and a city tax of 2.95½ it will be better to invest in some real estate and permanent improvement than let your money lie for the difference.

GEORGE.

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As a Decorative Material.

COLOR:

Dark grayish purple ground, interlaced with a net work of red and white veins.

CAN BE OBTAINED IN BLOCKS OF LARGE SIZE.
TAKES A BEAUTIFUL POLISH.

It is quarried in Devonshire and shipped F. O. B. Bristol, by

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Marble and Granite Merchants ....

BRISTOL, - - ENGLAND.

Buffalo, New York.

James Stewart & Co., general contractors, say that the outlook is that a large number of mills and factories will be built in the next few months in different parts of the United States. They recently got a contract for building six buildings for a cement company in a small town in Pennsylvania, the cost aggregating $225,000.

Among the projects which have come to their notice are those for two more manufacturing plants near the cement company's works in Pennsylvania, two near Boston and three or four in the Eastern part of this State.

Buffalo contractors are bidding for the construction of an elevator in Chicago, which is to be the largest one of its kind in the United States.

It is rumored that the Niagara Falls Power Company has made contracts with companies who will build four new factories at Niagara Falls. One of these is said to be an English carpet manufacturing concern, which has already bought seven acres of land as a site for a plant.

Fort Worth, Texas.

The Hoxie Bank building was let on Nov. 23 to Smith & Bardon, general contractors, for $45,000. It is a five-story building, St. Louis Roman press brick, Terra-cotta and Bedford stone trimmings. Most of the stone is in the entrance which is very elaborate. W. R. Sanguenette is the architect. It will be one of he finest bank and office buildings in the state.

The Texas & Pacific Railroad Company are getting ready to build their new passenger station. It is to be let some time in January so report says. It is to be of pressed brick and stone trimmings.

The Santa Fe Railroad Company got an ordinance passed at last meeting of city council closing 13, 14, 15 and 16th streets where they cross their tracks. They are going to build a fine passenger station report says, all stone. There will also be three viaducts built this coming season, two over T. & P. tracks and one over the Santa Fe track; they will have stone piers, so we are looking forward to a very busy year in the stone line in this part of the state.

A Giles, architect, of San Antonio, is getting up plans for a five-story stone front office building for that city.

James Riely Gordons, architect, of San Antonio was the successful one at Phoenix, Ariz., his plans were adopted for the new capitol building which is to be set in January. He is a good man for our line of the building track stone.

The Southwestern Telephone Company has bought ground here and are going to build an up-to-date building for their own use. So it looks like that long-looked-for prosperity has about reached this neck of the woods.

Potsdam, N. Y.

We are working on a $20,000 gatehouse and gate for the cemetery here, a gift of the Clarksons, a wealthy family living in Potsdam.

There are but five stone-cutters working and don't think they will put on any more at present for there will be nothing done in building line until spring.

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346-350 DEARBORN ST. CHICAGO
DESIGNERS AND ENGRAVERS
ORIGINAL DESIGNS AND SKETCHES FOR EVERYBODY
STRIKING IDEAS IN POSTERS
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The Most Durable Rope Made.

It.... Has No Equal.

AND ALL GRADES OF

IRON and STEEL ROPES AND STREET-RAILWAY CABLES.

ST. LOUIS, MO.

Marble in Utah.

There has been a marked advance in the marble industry of Utah county and some excellent stone has been taken from the Curtis and Probert quarries, near Springville. This is a grey marble, suitable for monuments, and is being used at the principal marble works in thhe country.

In Thistle canyon is found the bird's eye marble, which has its origin in fossiliferous substances. Great quantities of this can be obtained and sawed into almost any dimensions. This is being used for wainscoating, making table tops, soda fountains etc., and is said to be equal to the St. Lawrence and Tennessee marble. These deposits have been recently developed and will be worked extensively next season.

Those engaged in this industry in Utah county are R. H. Beesley & Co., Provo Marble Works, Provo; Thomas Childs, Springfield, and Harrison & Co., Spanish Fork.

The principal onyx beds are to be found in the mountains northeast of Pleasant Grove and are chiefly owned by Wadley and Dewey. Several car loads were shipped from these deposits to Chicago during the summer months. The class of onyx found in this neighborhood varies from a pure white to a chocolate brown.

Most of the onyx used in the city and county building at Lake Lake City was furnished by the Mexican Onyx company and taken from the deposits near Pelican Point, on Utah Lake.—Salt Lake Herald.

Classified Directory.

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STONE

VOLUME XVIII. FEBRUARY, 1899. NUMBER 3.

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MASONRY.*

PART I.

THE materials used in construction may be divided generally chemical elements combined in stable compounds. The into two classes, which, for want of better names, we may term the lower and the higher materials. The lower comprise earth and stone, whether used in the natural conditions in which they are found or in improved conditions into which they are artificially brought. The higher materials comprise metals and timber.

Between the two classes of materials there are marked differences. The first difference is in perishability. The lower class may be called imperishable; they consist of presence of oxygen cannot destroy that which is already completely oxidized. Whatever destruction may occur is of a mechanical character; they may be washed, broken or disintegrated, but in every case it is a mechanical action, the materials themselves do not change. By selecting materials adapted to their specific uses and so arranging them that the agencies of mechanical destruction are as far as possible kept away, we can approach more nearly to an everlasting construction than with anything else. On the other hand both timber and metal are perishable. Timber is an organic substance, subject to the most rapid forms of destruction; the natural exposure to the elements will destroy even the most permanent kinds within the limits of a human life, while the duration of the woods available for ordinary construction is but a few years. Timber is exposed to the more quick oxidation known as fire, the most rapid working agency of destruction which we know. Metal is more durable; it oxidizes slowly, unless exposed to active chemical agencies; its life may be measured by decades instead of years, but it must be an object of constant care.

On the other hand both of the higher classes of material have great tensile strength and can sustain the moderate deformations which are considered essential to the safe resistance of tensile strains; they are the only materials which the engineer is willing to use in tension.

*Extracts from a paper by Geo. S. Morison, Member Western Society of Engineers. Read October 21, 1898. Reprint from Journal of Society.

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We have, therefore, four materials used in construction; earth, masonry, timber, metal.

The first of these, earth, is that which has been used in the greatest quantities. Its use was the most easily understood. It required in its original working only the simpliest appliances. The first earthwork was probably built by a man with no other tools than his sturdy hands with their thick, coarse nails. It is to this day used more than anything else for dams, for levees, for that greatest of modern tools, the railroad embankment, for the most improved form of modern fortifications. Half civilized people used it to build their sacrificial temples and their burial mounds. If we read the stars rightly it is only by the use of enormous earth- that the inhabitants of a neighboring planet maintain a prosperous existence on their arid world.

Masonry is the building material of history. The greatest, and in many respects the finest, specimens of masonry now existing, were built in a time of which we have no records outside of the land in which they are found, while their extreme antiquity shows that masonry had been carried to a high degree of perfection when written history began. It is the material in which the great conconstructors of old expressed their highest skill. It is the material in which the great city of the Mediterranean recorded its conquest of the world. Until the present century it has been the only material of which great works have been made.

Next to earth, timber was probably the first material employed in construction. It is the most convenient of all; light, easily worked, strong, it is indispensable for many purposes: it offered ready means of comfort to the primitive man and where it is still abundant and cheap, it is used more than anything else, men generally preferring to take the risk of destruction in return for the convenience and economy which it offers. It has seen its highest development in our country where abundant forests have for the first time existed with modern machinery and tools to work them. The rapid development of North America has been made possible through the abundance and excellence of its timber. With care many of our timber buildings will be preserved for some centuries as historical relics, but sooner or later the wooden buildings of North America will have disappeared as completely as has the earlier timber architecture of India.

Metallic construction is new. It was only rendered possible by the advent of cheap metal work. Metal work was always expensive until the introduction of modern power; until the engineer began to manufacture power, the means for producing metals in large quantities did not exist; until metals could be produced in great quantities they were costly. We have as yet but one metal which is available for general construction and that is iron, whether in the cheap form of the cast, metal, in the more expensive and purer form of wrought iron, or in the latest development of ingot metal which we call steel, but which is much more nearly pure iron than cast iron is. This material being a metal is oxidizable and to that extent perishable, but it has far greater strength than anything else which can be used in construction. It gives the greatest results for the least expenditure of matter; where compactness and strength are required it is practically the only thing to use; it is pre-eminently the stuff of which tools should

be made, whether those tools be in a machine shop or be structures designed for some specific utilitarian purpose, but its uses are practical rather than more, its substitution for masonry, is only justified on economical grounds.

Masonry, therefore, the most permanent form of construction which man can make, the only material suitable for those works which passing beyond the requirements of tools, assume a monumental character and, enduring from one epoch to another, transmit to future ages the actual work of to-day; masonry respected for its antiquity, admired for its enduring futurity, is the subject of this lecture. I shall not consider the formulae by which its strength is calculated nor the details of methods by which it is made, but shall simply give a general outline of what it is and review the principles which must be followed to secure good results.

Masonry may be broadly defined as any construction formed of inorganic non-metallic material, in which the parts are so fitted together as to form a single united whole. In this broad sense it includes every variety of brick work, all kinds of stone masonry and all the monolithic work commonly called concrete. It excludes every form of embankment, whether of earth, or stone, in which the materials are held in their final position by the friction of pieces on one another, which limits the slopes on which sliding takes place.

Masonry, as defined in this broad way, may be divided into four general classes according to the material of which it is made. The first of these is adobe, the unburned brick of the Egyptians and the Aztecs, the usual cheap building material in all arid countries. The second is brick as we understand it, burned till it is harder and more durable than many kinds of stone, while its regular shape makes it an exceptionally convenient material to use. The third is stone in all its varieties. The last is concrete, an artificial stone.

Adobe, or unburned brick is nothing but earth of suitable character put in a special shape, but the form in which it is worked and the manner in which it is laid up, class it with masonry. Where protected from water it may be very durable, though less so than the other forms of masonry; the oldest church edifice in the United States, constructed in the sixteenth century, is built of adobe. Its manufacture is very simple; a suitable earth mixed with a little chopped straw is moistened and worked by a hoe into a proper degree of plasticity, shaped in a mould and laid in the sun to dry, the common dimensions being about twice those of ordinary bricks, so that an adobe is about eight times as large as a common brick. Adobes are laid up in a sort of mud mortar made of the same earth and the finished wall is usually plastered with the same kind of mud, thus making a solid wall of hard, dry, unburned clay. This, from time immemorial, has been the common building material of the Egyptians; their temples and pyramids were of stone; their burial places were caves cut in the rocks on the bluffs along the Nile, but their ordinary dwellings were, and still are, adobe. Adobe is the common, cheap building material of Mexico and a large part of Spanish America, but the Spaniards found it when they came. It is used in both the old and the new worlds in practically the same manner and in both its use goes back to an extreme antiquity. In a suitable climate adobe forms a most excellent building material, the heavy adobe walls, accompanied as often they are by thick roofs of

heavy wooden beams covered with the same material, are a great protection from changes of temperature outside. On the hottest summer day in countries where the outside temperature is often above blood heat the interior of an adobe building is always comfortable and cool.

Of all forms of masonry perhaps brick masonry is the most useful. It is in too common use to require description. The bricks should be made of good material and well burned; two kinds of material are used, the ordinary plastic clay which must simply be tempered with water, with perhaps the addition of a little sand, and worked into proper condition, and the various soft slates more properly called shales, which must be ground before they are used; building brick are generally

FIG. I. ANCIENT BAKERY AND FLOUR MILLS, POMPEII.

made of the former, paving and other specially hard brick of the latter. The harder a brick is and the less water it will absorb the better and more durable it will prove, but burning should not be carried to such an extent as to make a smooth, vitrified surface to which mortar will not adhere. In brick masonry mortar joints are frequent; they form so large portion of the whole that the strength of a brick wall is determined by the strength of the mortar. In a perfect wall the mortar and brick would be of equal strength; it is only when the bricks are very poor and the mortar very good that a wall fails by the breaking or crushing of the bricks. With good bricks and good mortar, well put together so that all the joints are thoroughly filled, brick masonry is one of the most durable things that man can build. Some varieties of stone may resist the elements better but no other material is as well fitted to resist fire; a heavy brick wall will stand almost uninjured when a granite wall close by will be splintered to pieces. The durability

and excellence of brick work are illustrated by its use in Rome. The aqueducts which cross the Campagna and the enormous buildings built in the days of the empire, were almost entirely made of brick, though facings and the finishings of which they have now generally been robbed, were of sculptured marble. The Roman bricks were very thin and hard burned, but their strength and durability has been due quite as much to the far-famed excellence of the Roman mortar.

Stone masonry may be considered the highest development of the art. It is at once permanent and beautiful and while in many respects no better than brickwork, it is susceptible of a finished elegance which no other material allows. Furthermore, the most durable stones have a much less absorbent capacity than

FIG. 2. MASONRY OF THE GREAT PYRAMIDS.

the best brick, and in places where masonry is exposed to moisture and to frost, as in the piers and bridges across our northern rivers, stone masonry is the best. There are a great variety of stones, but those in common use for masonry may be divided into four general classes: Granite, which is the hardest to work, the most durable against the elements and the least able to resist fire; basalt, which is generally found in inconvenient forms but which, when it can be quarried into suitable shapes, is excellent; limestones, of which there is an immense variety, from the best marbles, almost as durable as granite, to the common flinty limestones which go to pieces after the frosts of a few winters; sandstones, whose variety is almost as great as that of the limestones. The two first are azoic rocks; the two latter

are of sedimentary origin. The first requirement of good masonry stone is that it should be durable; the second, that it should be capable of being worked into convenient shape. It is possible to build good stone masonry in which mortar plays but little part.

Stone masonry may be classified in two different ways: By the shape in which the stone is used, and by the manner in which it is laid together. Masonry is divided into rubble and ashlar, while there may be combinations of the two, much good masonry having an ashlar face with rubble backing; in rubble masonry the stone are not cut; though they may be roughly blocked into shape, they are laid up in an irregular manner, with joints of varying thickness; in ashlar masonry the beds and joints are cut to vertical and horizontal planes, or more properly to planes parallel and at right angles to the line of pressure. The second division is into dry masonry and masonry laid in mortar; in the former the stones are placed directly upon each other, the bearings being taken at the points in which they come in contact; which even in the best cut stone work is not a continuous surface; in the latter the stones are bedded in mortar and the joints are filled with mortar so that, if the work is well done, the weight is distributed uniformly over the whole bed of each stone and the mortar excludes air and water from the interior of the work.

FIG. 3. "PISCINA MIRABILIS," FRESH WATER RESERVOIR, POZZUOLI, NEAR NAPLES, ITALY.

FIG. 4. EGYPTIAN MASONRY AT LUXOR.

Concrete is really an artificial stone; it is composed of broken stone or gravel enveloped in a matrix of mortar which surrounds every stone, filling all the voids, in the same way in which the cementing material of the mortar surrounds the particles of sand and fills the voids between them. A good concrete should be absolutely solid, there should be enough cement in the mortar to fill all the voids between the grains of sand and there should be enough mortar in the mass to fill all the voids between the stones; the mass should be so thoroughly mixed that this distribution actually takes place, a result which is seldom accomplished in quick, hurried work. Where stone cannot be had it may be omitted, and some of the best concrete ever made is formed entirely of cement and sand. While concrete is perhaps the most modern form of masonry, it is by no means new; while the Romans generally used brick for the unseen portions of their construction in many cases they used concrete; in Eastern buildings much of the interior work is of rubble masonry, containing so large a proportion of mortar that it is really concrete. Concrete is in very general use in Europe; its use is extending rapidly in America. Prejudices have been raised against it, though inferior work done in this country when it was first introduced, but it is within the limit of possibilities that an artificial stone can be made in this way, which will be as good and as durable as the natural stones which are commonly used; when this is accomplished the advantages of a truly monolithic construction will make concrete the best building material and, except for the facing of monumental works, where nothing can take the place of the finest stones from nature's laboratory, it may be universally used.

An engineer in designing a structure uses a factor of safety, which is the quotient obtained by dividing the breaking strain by the working strain. One of the rules which he follows in construction is to expose no material to a tensile strain when that material is not capable of some elongation without fracture, and the less such possible elongation the greater the factor of safety must be. Apply-

ing this rule, single stones are capable of a slight elongation under strain and may, therefore, be called on for some tensile resistance but only with an excessively large factor of safety. The same may be said of monolithic concrete though its general nature is such that the factor of safety should be still larger and the tensile strain permitted very small. Composite masonry, whether of stone or brick, cannot be depended upon for any such elongation, but as soon as a tensile strain occurs some of the joints are ligely to open. A masonry structure should be so designed that no tension exists in any portion of it, the only exception being in single stones like lintels over openings or the covering stones of a culvert, and these act only as beams. Furthermore, it is not enough to eliminate all external tensile strains but an external compression improperly applied may produce internal tension. Long compression members of timber or metal when tested to destruction invariably break through tension. If in any body the resultant of the compressive strains in any direction falls exactly in the center of the cross section normal to that direction, the compression on that cross section will be uniform throughout. If, however, this resultant moves from such center the unit strain increases on the side toward which that resultant moves and decreases on the side from which it moves, until, when the distance of the resultant from one face is twice that from the other, the pressure on the extreme edge nearest the resultant has been doubled and that at the more distant edge has been reduced to nothing. If the resultant moves still farther the further reduction of pressure on the more distant edge gives negative results, tnsion appears in the masonry and fracture occurs, not where the pressure is greatest but where it is less than nothing. While the fracture may not throw down the structure, it will cause cracks and thereby destroy the monolithic character of the work.

Though tension should never be permitted in masonry it is still possible for changes of shape to occur of the same nature which take place when a beam deflects under a load. In a beam this deflection is caused by compression in the

FIG. 5. CAIRO (ILLINOIS) BRIDGE.

FIG. 6. MEMPHIS BRIDGE PIERS.

upper portion of the beam which softens the fiber and tension in the lower portion which lengthens the fibers. Similar results, so far as distortion are concerned, may, however, be obtained by varying compression, and this is what takes place in a piece of masonry. In a long masonry column, for instance, a force applied at the center of the column would simply compress that column, shotening it in proportion to its length and the strain. If, however, this pressure instead of being applied at the center were applied at the edge of the middle third a compression would take place on one side of the column equal to double what under the former conditions took place throughout the whole, while there would be no compression on the other side; the column might, therefore, be bent perceptibly out of shape without the existence of any tension in the masonry. Masonry has a modulus of elasticity, or as some physicists would prefer to call it, a coefficient of compression. Its elacticity must be recognized and masonry is susceptible of an amount, though a small one, of deformation and this deformation is not infrequently observed in practice. The piers of many bridges bend back and forth and this without injury to the masonry.

The ideal masonry would be absolutely monolithic; this result, however, is never obtained except in concrete. In all other kinds two conditions are relied upon to produce this result in some measure. The first of these is the friction of the stones upon each other; as friction is directly proportionate to pressure the best results are obtained when the maximum pressure is combined with the least tendency to move on the lines of friction; this condition obtains on planes which are at right angles to the line of pressure, so that the pressure on the plane is a maximum and has no component in the only direction in which the stones can slide. Furthermore, this friction should be utilized to tie the successive stones together as much as possible; the stones in one course should tie together those

in the course below, that is, the stones instead of being superimposed on other stones should be placed over the joints between the stones below, so that stones cannot be pulled apart without overcoming this friction. This breaking of joints is a fundamental principle of good masonry. The most perfect form of a pier intended to resist weight would be one formed of successive courses, each consisting of a single stone, the pressure being taken at the successive joints on planes at right angles to the line of pressure. In very small structures this is sometimes done with excellent results; in larger works the nearest possible approach to this is obtained by using successive courses separated by parallel planes, the stones of one course breaking joints with those of the course below and binding those stones together by this frictional resistance. The best quality of ashlar masonry fulfills this condition better than anything else, well bonded brick work does it also.

The other condition which tends to produce monolithic work is the use of mortar, with which all interstices should be filled and which has the double effect

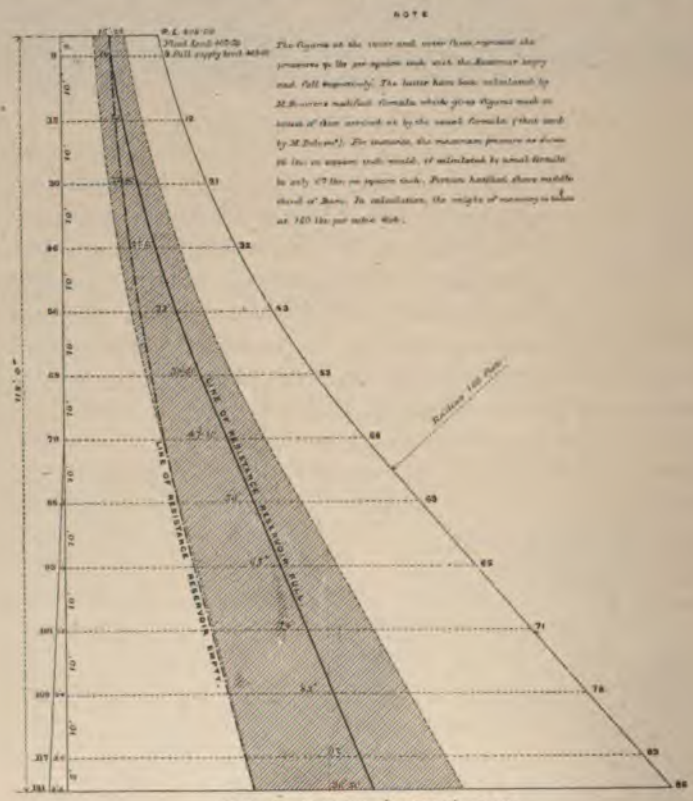

FIG. 7. TANSA (INDIA) DAM.

of reducing the pressure by distributing it over surfaces instead of taking it on points and of very greatly increasing the coefficient of friction by its adhesion to the stones. The better the mortar the better these results. A perfect mortar would be as strong as the stone and would adhere to the stone as firmly as the particles of stone adhere to each other (a degree of excellence which we shall prob-

ably never attain. With such a mortar the work would become absolutely monolithic and it would no longer be necessary to use beds at right angles to the line of pressure or to break joints, as both beds and joints would disappear in the absolute monolith which would result.

With the mortars which we now use it may be said that the closer the work, the truer the fitting and the less amount of mortar required to fill all voids the better the work will be. With ordinary workmanship, however, there is danger of carrying this too far. It is better to have a thick bed of mortar which will absolutely fill the space between two courses of stone so that every bed is sup-

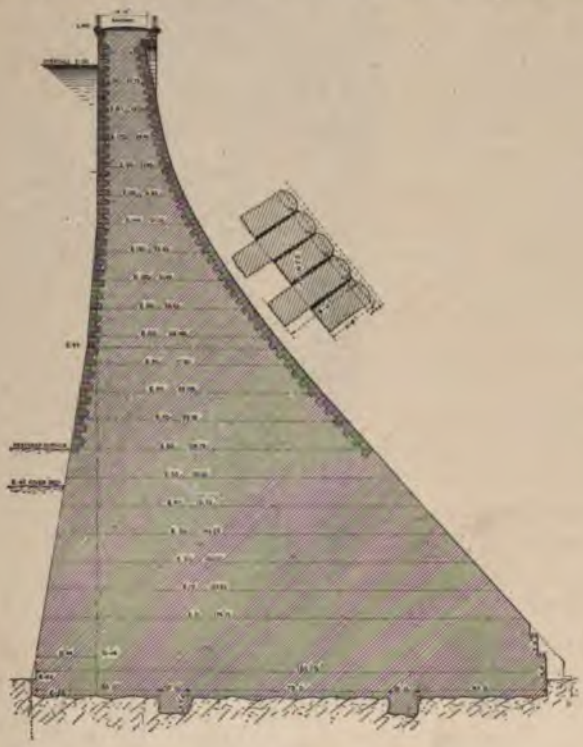

FIG. 8. CORNELL DAM.

ported throughout by the mortar than to have a thin joint in which this is not done. It is much harder to fill thin joints than thick ones, and in ordinary practice it is not wise to make the joints too thin. I have usually put a clause into specifications for first-class masonry providing that thin horizontal mortar joints will not be insisted on, but that every stone shall be set in a full bed of mortar and settled to a proper bearing.

There is a common idea that the same degree of excellence, or of inferiority, should be permitted in all features of a piece of work. In other words, that in second class masonry in which little pains are taken in fitting the beds and joints, a poorer mortar may be allowed than would be required in first-class ashlar work. This is entirely wrong, the closer the work, the nicer the fitting and the more perfect the

FIG. 9. PRIZE DESIGN CONNECTICUT AVENUE VIADUCT, DISTRICT OF COLUMBIA.

shape of the stones, the greater is the work done by friction and bonding and the less is the duty which the mortar performs. If poor mortar is to be permitted at all it should be allowed only with the very best stone work. The inferior classes of masonry, like rubble work, if they have any considerable duty to perform are only safe when laid up in very best quality of mortar. This is illustrated by the work of different nations. The closest stone cutters the world has even seen were the ancient Egyptians; the great pyramid is a mass of ashlar masonry, though the face stone was stolen by Mohammedan invaders to build the mosques and seraglios of the city of Cairo; but in one place, where the sands of the desert have been uncovered from a small remnant of facing near the base of the pyramid, I found a joint on the top bed of a stone which did not exist on the face; a careful examination showed that this could not be real joint, but must have been simply the mark of the tool which was used in trimming the end of the stone which formerly stood in the course above, and yet the real joint was so close that it could scarcely be distinguished from this tool mark. The pyramids were laid up in mortar, but the amount used was almost infinitesimal and was simply an inferior lime paste; the excellence of the stone work rendered the quality of the mortar unimportant. The masonry of India is very different; it is made largely of small stones with a facing of fine work, but the mortar, the work of the patient, mild Hindoo, is very good; the masonry is of excellent character and very strong; the smallness and poor fitting of the stones are made up for by the excellence of the mortar.

As an extreme instance of imperfect specification I may mention a case which recently came to my attention: a wall of rubble masonry, with poorly bonded stones and irregular beds, laid in inferior mortar, was run up quickly to a height of nearly fifty feet, when suddenly the exact result which was to be expected occurred: the mortar in the lower courses yielded, the stones moved on each other and the entire wall collapsed into a heap of loose stones and looser mortar. Poor as the mortar was, if the wall had been built of cut stone, well bonded, it would have compressed a little and have stood. Poor as the stone was and weak as the bonding was, it would have stood if the mortar had been good enough to bear a moderate pressure and to adhere to the stone; the mortar neither adhered to the stone nor was able to carry the weight of the wall; fortunately destruction came before the building was completed.

(To be continued.)

THE OLD ROMAN AQUEDUCTS.

THERE are no more striking examples of the grandeur of simplicity in the design of stone bridges than the old Roman aqueducts. The long lines of arches still standing on the otherwise deserted plains of the Campagna, are examples likewise of the splendid character of the workmanship of the Romans, who apparently built their engineering structures to last for all time.

The rectangular stone piers were capped with simple stone copings, the full semi-circular arches sprang directly from these, while the depth above the arch ring necessitated for the conduits, ornamented by simple belt courses and surmounted by a coping and a triangular copping, gave the structure a dignity which even in the ruined condition of the present time has not been lost.

The engineering skill displayed in their design was remarkable, showing that the Romans were well informed in scientific matters. The conduits have uniform grades for long distances, having been apparently constructed from precise levels of the country over which they were built.

The stone of which they were constructed was carefully squared and in some instances different colored stone was employed for architectural effect. Most of the work was done upon them during the winter season, as the masonry was thought to dry out too quickly if laid in the summer. There were nine aqueducts used to supply the city of Rome with water in the time of Frontinus, the Aqua Appia, Anio Vetus, Aqua Marcia, Aqua Tepula, Aqua Julia, Aqua Virgo, Aqua Alsietina, Aqua Claudia, and the Anio Novus.

Of these the Aqua Claudia was the most remarkable for its construction and arrangement, having a length of nearly fifty miles and carrying water from two streams above Tivoli. Nearly one-third of its length was carried on arches.

RUINS OF AN OLD ROMAN AQUEDUCT.

THE BRIDGE OF THE RIALTO.*

THE city of Venice is built upon two islands, which are separated by a serpentine waterway, known as the Grand Canal, across which is built the bridge of the Rialto. The name Rialto is derived from the original name of the island first settled—Ripa Alta.

The foundations of all the structures were made with great care, requiring the use of masses of concrete or the driving of piles.

The bridge of the Rialto was constructed from the design of Michæl Angelo, in 1578. As is well known, the painters of this period were also architects of recognized ability and applied this knowledge to the design of engineering works as well, with the result that such structures partake very largely of the character of works of architecture, being decorated with its conventional details.

The span of this arch is 96 feet 10 inches and the rise 20 feet 7 inches. The arch ring is handsomely molded, while the spandrels, the masonry of which is laid with radial joints, are decorated with figures of angels in relief and tablets bearing inscriptions. At either end are niches of beautiful design, forming places for other figures.

The bridge carries two rows of shops, formed by arcades, between which is a passage. The principal footways on the outside are supported by corbels, an arrangement which causes the depth at the center to appear more shallow than it is in reality—on account of the great overhang.

The footways are protected by balustrades of beautiful design, and on account of the ascent being steep marble steps are provided.

The arcades are quite a study in themselves, the large central arches forming a cross passage. The six arches on either hand springing at different levels, present a remarkably good solution of this difficult problem in design. The lack of a thick abutment at each end and the shallow depth over the haunches of the large arches are faults which are to a great extent lost sight of, owing to the striking character of the entire bridge.

*Subject to Frontispiece.

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ROMAN CONSTRUCTION.*

MANY books have been written and innumerable plates have been published describing and illustrating the wonderful architectural and engineering works of the ancient Romans.

The history of Roman art is well known. Their architectural forms are recognized by every intelligent observer, and the minute details of their style and orders have been familiar to architectural students for the last three centuries.

There is hardly a known fragment of Roman architecture in existence that has not been carefully measured, drawn and published to the world during the present century.

And yet, with all this widely published knowledge of Roman art and architectural forms, there has been very little attention given in modern times to Roman methods of construction, and very few, even among architects and engineers, are aware of the fact that the ancient Romans, especially of the best days of the Roman Empire, devised and perfected a method of construction perfectly adapted to their gigantic works and possible of execution with unskilled labor and with the cheapest and most common materials.

Nearly all writers who have attempted to describe Roman buildings and the materials with which they are built, have classed them as of cut stone, or of brick faced with marble.

Others who have investigated a little beneath the surface have described some Roman walls as a combination of brick and rubble stone work, with occasional bond courses, extending entirely through the walls, consisting of large flat tiles.

Vitruvius, the earliest architectural writer whose works have come down to us, declares, in the introduction to his ten books, that he has developed all the principles of the art of architecture. Yet, while he describes very minutely all classes of building material and their proper use, he gives no hint of what the ruins show to be the true Roman construction of walls and arches, which method became general about his time. Whatever Pliny and other ancient writers have recorded of Roman construction they appear to have copied from Vitruvius.

During a visit to Rome in 1882 the writer was much interested in examining the stupendous ruins of buildings, aqueducts, etc., and noticed what to him was a strange discovery—that the walls and arches of such buildings as the Baths of Diocletian and Caracalla, the Basilica of Constantine and many other ruins were not of bricks, as he had been led to suppose, but of great masses of concrete faced with bricks. In many places where the brick facing had been stripped off the concrete mass presented a rough face with numerous indentations, as if bricks had been laid diagonally with the corners penetrating the concrete. This was a new revelation to him, but he had neither the means nor time to investigate

*Reprint from Journal of the Societies, By G. W. Percy, Member of the Technical Society of the Pacific Coast.

further than what was on the surface and exposed to view. The discovery, however, added new zest and desire to read whatever he found about Roman construction. When in 1885 a book was published by J. H. Middleton, an English architect, entitled, "Ancient Rome in 1885," giving the result of extensive investigations, and revealing the fact that all so-called brick walls in Rome of ancient construction were of concrete, faced on both sides with triangular bricks. Middleton declares that there are no walls of ancient Rome built throughout of brick, and that walls only seven inches thick are faced with very small triangular bricks and filled with concrete. See Fig. 1, a.

This made clear the cause of the indentations which had so puzzled the writer, and showed a logical intent on the part of the builders.

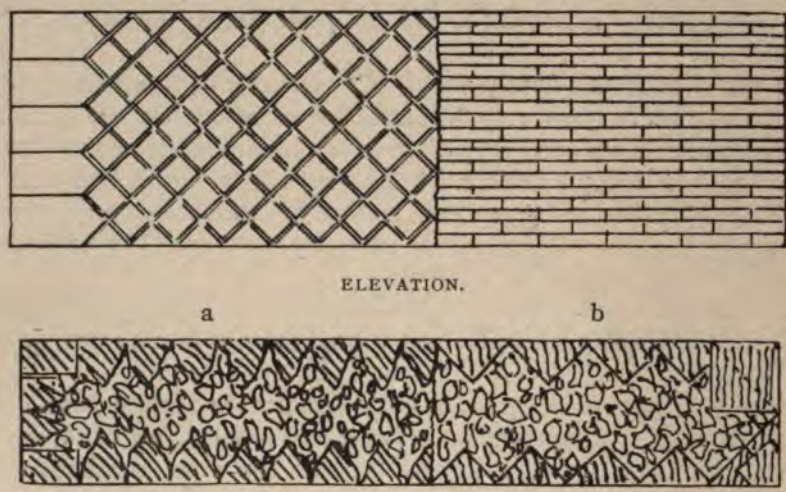

FIG. I. PLAN OF WALL.

In a more recent work, "The Art of Building Among the Romans," written by Auguste Choisy, a French architect, a translation of which by Arthur J. Dillon has been published in the Brick Builder during the years 1892-95, makes clear to English readers for the first time the system practiced by the ancient Romans. To this work the writer is indebted for the graphic illustrations of this paper, and to some extent the descriptions.

The etchings by Piranasi show how some of the ruins appeared one hundred and fifty years ago, while the photographs show the appearance of other ruins at the present time.

It will be seen by examining these etchings and photographs that in many places what appear on the surface to be brick arches over openings and relieving arches through the body of brick walls have fallen out or have been destroyed, and the remaining mass shows that the arches, like the plain facings, were but skin deep.

A close examination of the interior surfaces of domes and the soffits of large arches often reveals a framework of thin brick arches forming a skeleton of bricks imbedded in the mass of concrete or rubble work.

Auguste Choisy made a thorough examination of these and other peculiarities and arrived at the following conclusion: That Roman masonry generally consisted of an agglomeration of small stones and mortar, with facings of cut stones or triangular bricks, except for foundations and other works below the level of ground where the earth, and sometimes timbers, served to confine the mixture. This concrete or fine rubble work is of two kinds—that which was placed in trenches or behind solid stone revetments was of rammed masonry, formed by spreading a layer of mortar four or five inches thick, and then spreading over it

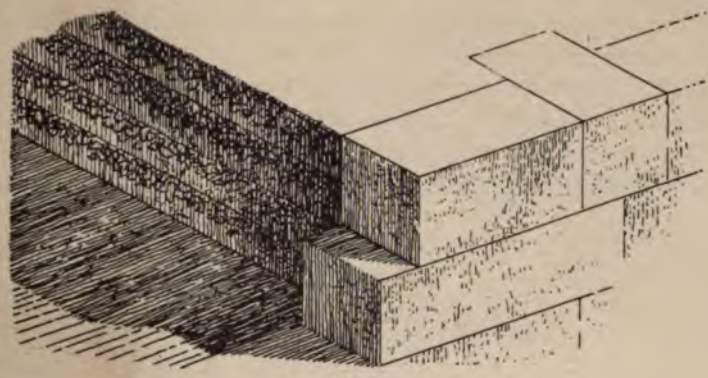

FIG. 2.

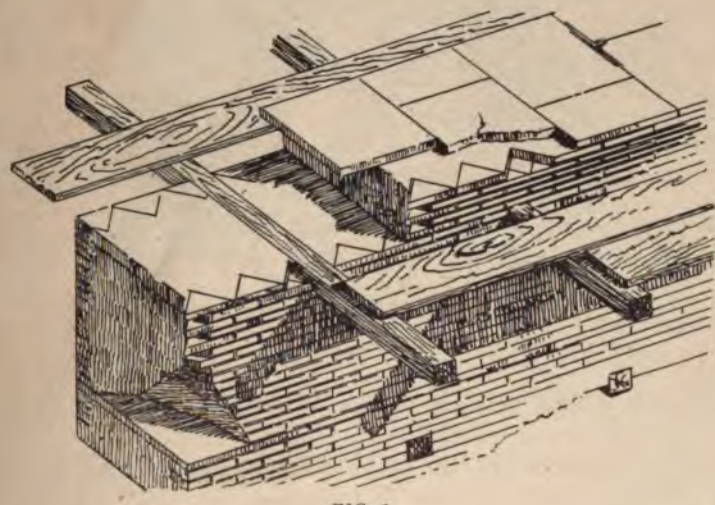

FIG. 3.

a layer of equal or greater thickness of small broken stone and ramming the stone down into the bed of mortar, thus forcing the mortar into all the interstices and bringing some of it to the surface. Then a thin layer of very fine fragments and dust resulting from the facing of the cut stone was spread, which prevented the mortar from adhering to the feet or tools of the workmen, and the whole was again rammed solid, when the operation was repeated with a fresh layer of mortar,

rock and dust, thus making a very compact mass in well-defined layers eight or nine inches in thickness. Fig. 2.

This method seems to have been employed in all cases where heavy cut stone facing or earth pressure gave sufficient resistance to the outward thrust caused by the ramming.

The other method of building with conglomerate masonry and where ramming is not employed is by far the most common, and is always found where brick or small stones are used for facings. These facings were doubtless laid one or two courses at a time and for the same purpose as the larger stones, to confine the fresh rubble and to form straight and true faces to the walls, which were afterwards veneered with marble or covered with stucco.

Some writers have assumed that the interior filling was mixed as concrete is now, and poured while in a semi-liquid condition between the facings, but Choisy demonstrates quite clearly that such could not be the method employed, by that layers of lime mortar, as before only form one to one and a half inches

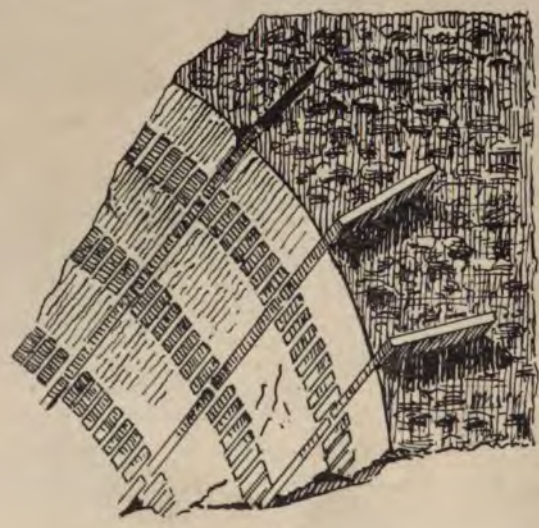

FIG. 4.

in thickness, were spread between the facings, and then the broken fragments were placed by hand and pressed down into the mortar. This is shown by the fact that the stones are always placed on their natural bed, and where pieces of pottery are used they are always placed with their faces following the horizontal plane, and again where fragments two or three inches thick are used, as sometime occurs, it is frequently found that the layer of mortar spread over the top does not go down between these large fragments to meet the lower bed of mortar, thus leaving gaps in the vertical joints which would not occur in a mixed semi-liquid concrete, and which are seldom if ever found in the rammed work.

The triangular bricks used for facing such walls and confining the rubble were from one foot to twenty inches long, and from one to one and one-half inches

in thickness, and laid generally with very thick joints, often one inch in thickness, of lime mortar, generally with pozzuolana used in place of sand.

Often, in the earlier works, the faces of the walls were of small stones about six inches square on the face, and from ten to twelve inches long, and laid with diagonal joints forming what Vitruvius calls "reticulatum opus." Fig. 1, b.

In all these cases we see that the principal object of the brick and small stone facings was to confine the rubble work and protect it during the process of setting and hardening, while at the same time it was thoroughly incorporated in the mass of the wall.

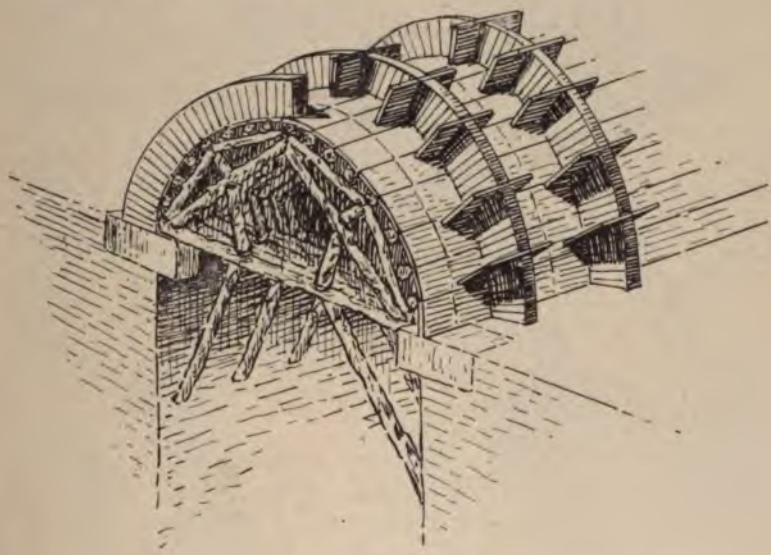

FIG. 5.

In this manner all expense and wastefulness of temporary curbing was avoided, and substantial walls were erected, largely with unskilled labor and with the commonest materials.

In building walls of this character it is evident that some method of bonding the two opposite faces at intervals should be employed, and this (Fig. 3) the Romans effected in two different ways. Often both methods were employed in the same wall.

In the first method sticks of roughly hewn wood were placed, extending entirely through the wall. Vitruvius refers to this method of bonding, and says in Chapter 5, Book 1: "The walls ought to be tied from front to rear with many pieces of charred olive wood, by which means the two faces thus connected will endure for ages. The advantage of the use of olive is that it is affected neither by weather, by rot nor by age. Buried in the earth or immersed in water, it lasts unimpaired, and for this reason not only walls of cities, but foundations and such walls as are of extraordinary thickness, tied together therewith, are exceedingly lasting."

It is quite probable that these bonding sticks were allowed to project on both sides of the walls to support scaffolding for the workmen and materials, and, when the walls were finished, they were cut off flush with the face.

The wood has rotted out from all these Roman walls, but the imprint in the masonry gives proof beyond question of their former existence.

The second method of bonding, which has proved more durable than even charred olive wood, is also shown in Fig. 3. It consists of flat tiles of burnt clay, or large bricks, about two feet square, and from one and one-half to two

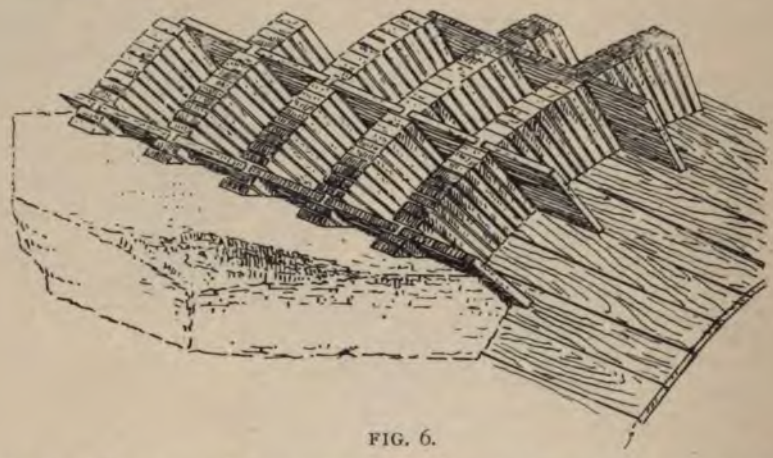

FIG. 6.

inches thick. These are often used in single layers from four to eight feet apart, and sometimes with two or three courses together. This method of bonding is a strongly marked peculiarity of Roman walls wherever found in Europe.

But it is in the construction of vaults and arches that we find the ingenious method of the Romans carried to its greatest perfection, and the greatest saving of skilled labor and expensive materials.

While arches of cut stone with radiating joints were used by the Romans in their bridges, triumphal arches, city gates and some other monumental structures, rubble vaults were far more common and were built on a most stupendous scale.

These vaults, formed of small materials, were of infinite variety, and are found covering rectangular and polygonal spaces, rotundas and exedras, for, being, as it were, moulded, they could be adapted to the most varying forms, and could be made to meet all of the numerous requirements of planning.

The Romans may or may not have been the inventors of rubble vaults; that is to say, of vaults of small stones bound together with mortar, but it is certain that before them no one thought of constructing vaults of large span of such materials. With them it seems to have been devloped during the latter days of the republic and the early days of the empire, or about the beginning of the Christian era.

The system developed rapidly, and the Pantheon is preserved to us, a masterpiece of the art and one of its earliest examples.

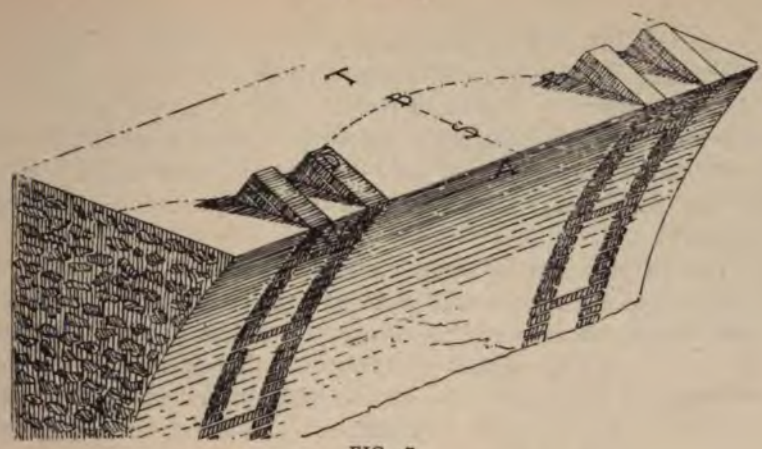

FIG. 7.

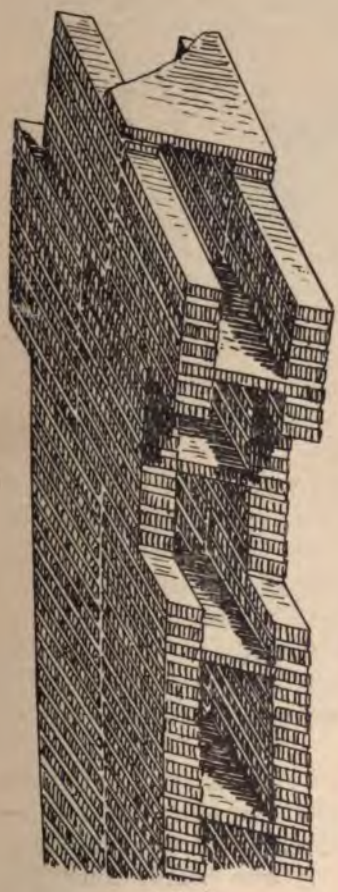

FIG. 8.

FIG. 9.

If one inspects an edifice vaulted with rubble, as for example the great Baths of Caracalla, he will perceive on the face an arch of brick with radiating joints, and behind these face arches a rough masonry similar to the interior of the walls we have described, but if one examines these masses of masonry more closely he discovers courses of an entirely separate construction imbedded in them, real ribs, sometimes entire networks of bricks forming skeletons in the body of the rubble.

This skeleton must not be considered as a series of relieving arches built at the same time as the rubble and intended to strengthen it. These arches of bricks in the Roman vaults were built first, with radiating joints and bonded to each other and to the face arches at intervals with large tiles, thus forming a complete framework which could be built on a light and inexpensive centering, and which in turn supported the body of the arch as it was carried up with horizontal courses exactly as described for the walls.

Fig. 4 shows the appearance of such a vault with the facing bricks removed.

It is evident that the construction of wooden centering, of sufficient strength to carry such massive arches in a perfectly rigid state while being built, would be

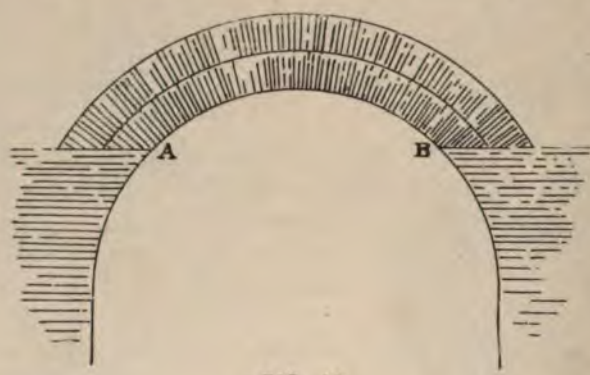

FIG. 10.

a work of great expense and delay, requiring vast quantities of timber, considerable skilled labor and a great deal of time, all of which the Roman builders sought to avoid using unnecessarily.

Some centering indeed was necessary to support the light ribs of bricks on which to form the rubble. Such centering was constructed in as light and crude a manner as possible, generally of round or rough-hewn logs, supported on corbels of brick or stone projecting from the wall, roughly formed to the curve of the arch with bricks and earth, and, where necessary, further supported by vertical props. Fig. 5.

This rough centering was often paved with a layer of large, thin, burnt tiles, laid with open joints which would revive the rubble masonry and adhere firmly to it, thus forming the permanent soffit of the arch when the centering was removed. At other times it was covered roughly with boards which have left their imprint in the masonry of the arches.

The ribs or armatures of the arch were then turned rapidly and roughly as is shown by their irregularity in many of the ruins. They were usually constructed with bricks about 6x24 inches, slightly wedged and laid in strong lime mortar. At intervals of two feet or more large tiles or bricks about 24x24 inches were built in, forming wings, as shown in Fig. 5, or bonding the ribs together, as shown in Fig. 6.

At other times the ribs are built in pairs, with a space of eight or ten feet between them, as is shown in Fig. 7.

In still other cases, where very large arches were to be turned, as in the Basilica of Constantine, where they are about seventy feet span, these ribs were made double in height, as is shown in Figs. 8 and 9.

These light ribs of brick, once completed and bonded together over the rude centering, were of sufficient strength and rigidity to support the rubble

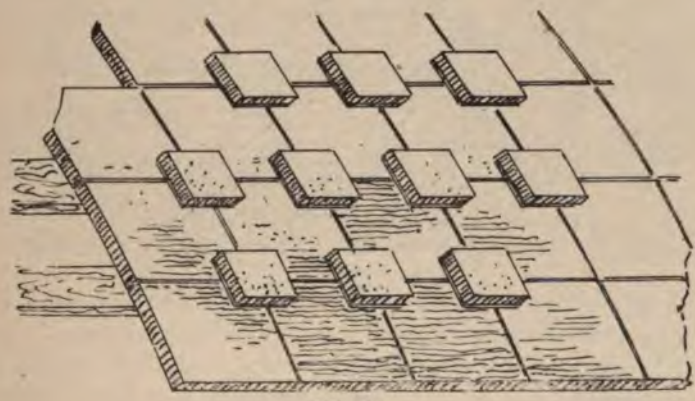

FIG. 11.

work as it progressed, and were swallowed up by it, becoming thoroughly incorporated as a permanent part of the construction.

It is evident also that the work need suffer no delay while the centering and ribs were bing constructed; for, as shown in Fig. 10, the overhang of the walls was slight for about one-third of the height of the arch, and up to that height would cause little or no pressure on the ribs or centering, but it was necessary that the ribs should be completed before the work was carried higher.

Many barrel vaults of smaller dimensions were turned on armatures of two courses of bricks or tiles laid flatwise, the lower course laid continuous, of large bricks, and the second of smaller bricks covering the joints and forming blocks or bands as represented by Figs. 11, 12 and 13, the top course being laid in plaster or quick-setting mortar.

Of this type are many of the vaultings in the Baths of Caracalla.

When it came to groined vaultings, the Romans practiced the same economy in the employment of skilled labor and costly materials. It may be said in general that where practicable the Romans avoided the intersection of barrel vaults, but, where the requirements of the plan demanded it, they sought to make both

barrel vaults of the same width, and where that was not practicable they usually stilted the narrower one so as to bring the top level with the large arch.

The centering and ribs were constructed in general as has been described for barrel vaults, but with the precaution of always having rigid ribs to form the groins (Figs. 14 and 15), or, if flat tiles were used, an extra course was laid long the line of the groin. (Fig. 16.)

In building circular domes the same elaborate system of ribs and skeleton armature was carried out.

The dome of the Pantheon, the largest, oldest and most perfect dome in masonry, and which some writers have described as of solid brickwork, others of

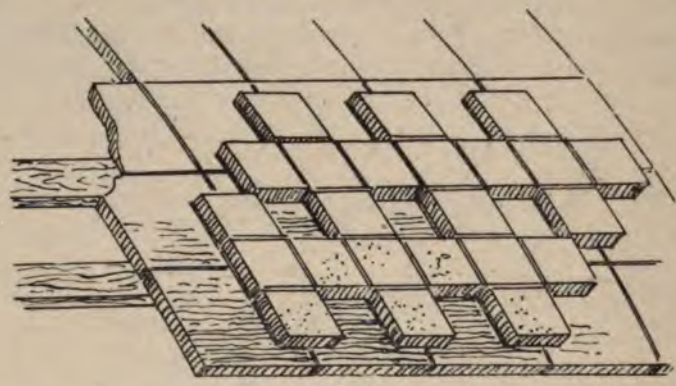

FIG. 12.

solid concrete, proves by investigation to be of the fine rubble work we have described, with an elaborate system of ribs and arches incorporated.

Piranesi, the famous etcher of the last century, who devoted his life to producing in this manner the most perfect representations of the ruins and architectural features of Rome, made extensive investigations into the structure of the dome of the Pantheon while repairs were being made, and produced an etching of which Fig 17 is a diagram.

The methods here presented are not the only ones employed by the Roman builders in constructing their vaults and arches. Many special devices were adopted as the difficulties and necessities presented themselves, and many combinations of different methods were employed, the object appearing to be always to prevent waste of valuable materials and skilled labor in erecting temporary and auxiliary works.

A study of these ingenious contrivances not only gives us an insight into the conditions under which Roman builders labored, but must increase our respect and admiration for their engineering and constructural ability.

Study of the ruins of Roman work indicates that the methods here described arrived at their greatest perfection during the first two centuries of the Christian Era, gradually falling into disuse and disappearing in the fifth century, after which few buildings of magnitude were erected in Rome until the days of the Renaissance, when the old Roman methods had been long forgotten, only to be investigated and comprehended in these latter days of the nineteenth century.

DISCUSSION.

President Molera.—When lime mortar is buried for a year or two in pits, it is supposed to absorb carbonic acid from the air, thus tending to return to its previous state of lime rock. The reaction takes place in the mortar itself. I sup- that in these large pits the covering was not such that it was hermetically sealed against the air, and that the air inserted itself into the mass. An analysis of the mortar in the ancient work of the Romans shows there is a great deal of carbonic acid in it.

Q.—Mr. Percy, as you have described the mortar with stones put in it, is it not something like our concrete? Do you know whether our modern concrete was known to the ancient Romans, and used by them?

Mr. Percy.—I think not. I think the method described by the writer I have quoted from so liberally must have been the one employed. If the materials were

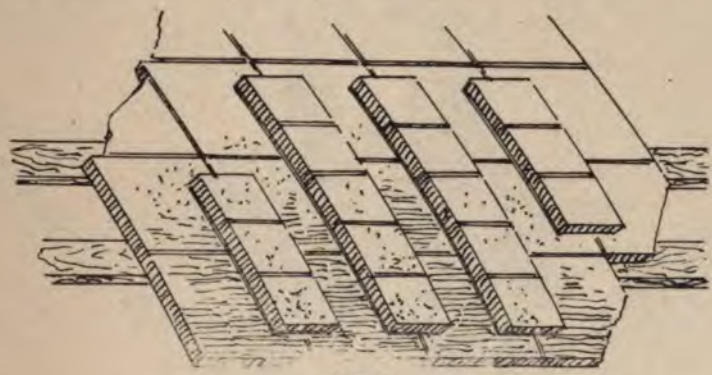

FIG. 13.

mixed together and put in as we put in concrete now, there certainly would not be any well-defined layers. He says that in large work it is in layers eight, nine or ten inches thick. Evidently the mortar was first put in and the stone was then rammed down into it, bringing the mortar to the top. The most common class of work is with brick facing. If the mortar had been poured in in a semi-liquid state the layers would not be so well defined. It is self-evident that the small stones or fragments of pottery were put in by hand, for they are always placed in a horizontal position. If they had been poured they would be in all positions. Then, again, in these layers there is always mortar at the bottom, growing less as it comes upward in the course. The whole thing is logical when we consider that, in building a wall, common square bricks would not make a very good bond, but in such masonry the rubble filling with triangular brick facings makes an excellent bond. There could not be a better bond devised than the triangular brick. This also would be an economical way of building walls, for it could be done with unskilled labor. It is very evident that the Romans had abundance of labor. They had great numbers of captives, and even their soldiers were put to work on these buildings and great structures. All sorts of labor were employed. It is apparent that this method was adopted so that a great amount of unskilled labor could be used in doing the greater part of the

work, using skilled labor only for the finishing touches and the ornamentation. The ornamentation is of a Greek type, although the construction is Roman. They brought Greek architects and Greek workmen to Rome to do this clas of work. With this outside finish and ornamentation stripped off we now see the real Roman work and construction.

Q.—Do you understand this construction would apply to such buildings as the Colosseum and the great aqueduct?

Mr. Percy.—Yes, the Colosseum is of this method of construction, and of cut stone. The outer wall, and the second series of arches, and a good part of the third series are of massive cut stone, but the interior parts are almost entirely of bricks and of small fragments of stone and mortar. Perhaps it would be proper

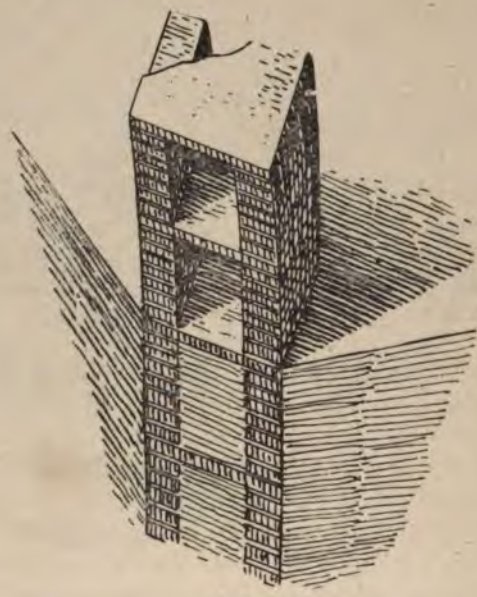

FIG. 14.

to call it rubble work; evidently the mortar and stone were put in by hand. It looks something like concrete, and it may be properly called a fine rubble. The cut stone is travertine. Some of the piers and arches of the aqueducts are of cut stone. The piers and arches of the largest aqueduct in Nero's time, for instance, were of brick and rubble. A very interesting thing about it is that some of the arches proved too weak to carry the weight, and they have been reinforced by other arches built inside of them, and the piers have been thickened. The inner arches were built entirely of brick. A few inches were left between the crown of the new arch and the under surface of the old arch, and then on one side of the wall this place was bricked up, and this mixture of stone and bricks and mortar was rammed in from the outside into all the space between the two arches, thereby strengthening the original arches.

The Roman brickwork is generally made of thin bricks, often not over an inch in thickness. It is a very common thing to find the joints as thick as the bricks are. The mortar between the bricks has coarse sand in it. This is not intended to be seen, but to be covered up by the hydraulic cement I have spoken of, which also keeps the water from penetrating.

All the great arches, including the triumphal arches, were built of cut stone, and not of concrete and brick; also most of their gateways. The oldest Roman work is entirely of cut stone, and no mortar was used. The stones were fitted very closely together. About the time of Christ, roughly speaking, this method of using triangular bricks became the common method, and is particularly shown in those monuments built in the first, second, or third centuries of the Christian era.

The Romans at first used a volcanic tufa quarried on the site of Rome. It was not very enduring, and not very hard. All walls that were exposed were covered

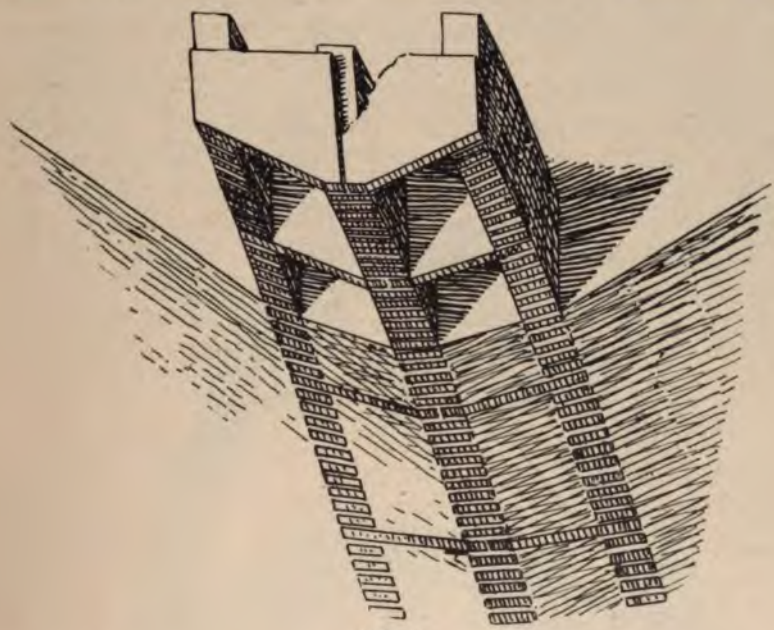

FIG. 15.

with stucco, both for appearance, I suppose, and preservation. As the Romans became more powerful, they wanted to build more enduring buildings, and they went to the foothills and mountains beyond, twenty-five or thirty miles, where there are excellent quarries of stone. You have a sample of this stone here in Golden Gate Park in the Keyes monument. That is Roman travertine. It is very hard, enduring limestone. The Colosseum and St. Peter's are built of that material. It was used very generally for building purposes. Temple building, up to the time of Christ, or soon after—such temples as the Temple of Saturn—are all built of white marble. In the first three centuries of the Christian era the Romans were not satisfied to use white marble, and they brought the richest

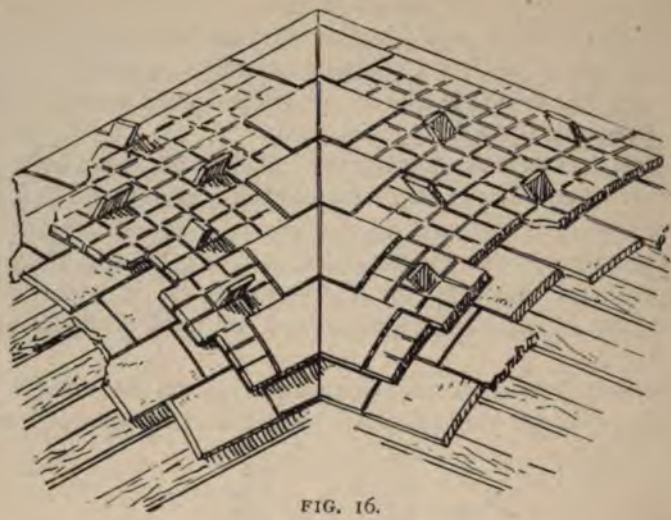

FIG. 16.

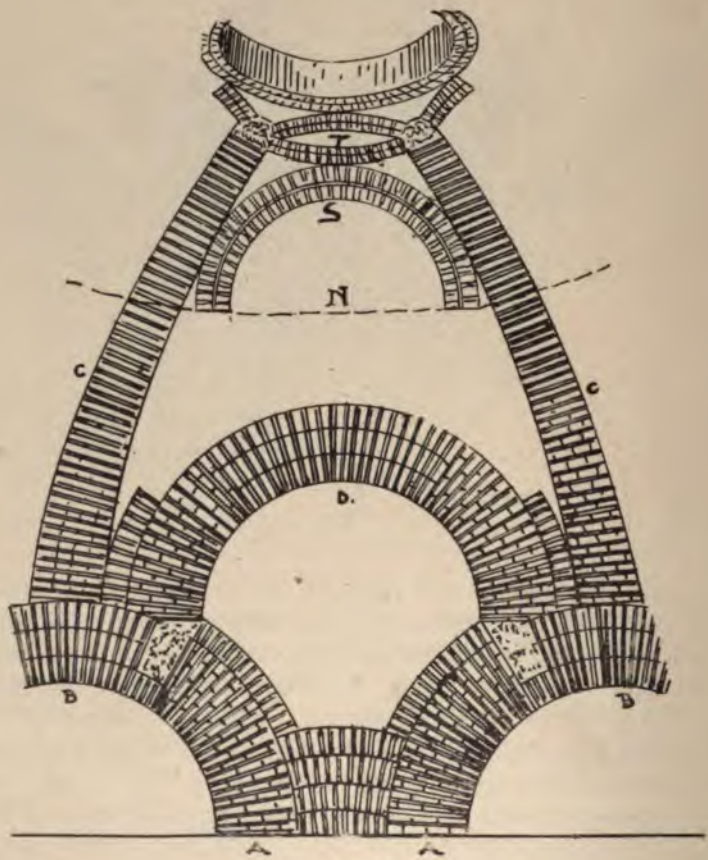

FIG. 17.

and finest varieties of marble that could be found anywhere in Africa or Asia. The most of this marble has now disappeared, but fragments are still found.

The stone dug out of the catacombs was a soft tufa. I do not think any of the cut stone came from there, or that it would be practicable to quarry stone out of such narrow passages. The Romans probably made use of the tufa taken out of the catacombs, but they could not have quarried building blocks of stone out of passages four and eight feet high and extending for miles in all directions. No sane man would take that method of quarrying stone, and certainly the Romans were logical people, as we have seeen in the construction of their buildings. The catacombs I believe were made solely for burial purposes. The stone taken out is inferior material, at best, for building purposes. We find in this concrete or rubble work something of a guide to the age in which it was used. In the earliest work the tufa is the most common material in the concrete or rubble work. In a later period we find the travertine, and, still later, fragments of all kinds of marble, of chippings of marble, and of basalt and other stone, showing that the chippings from the stone they used for facing their temples all went into their concrete or rubble work, and nothing was lost or wasted.

I do not know of any granite near Rome, and yet we find granite used there in modern times. The church of St. Paul was burned in 1828 and has been rebuilt. There are a great number of very large columns, and they are of polished gray granite. Everything else is marble, but the columns are of granite. Where the granite came from I do not know. We find here the architectural works of the Greeks. They not only rubbed the joints of stone together to a perfect joint, but even polished the joints. I do not believe there ever was such a waste of labor anywhere in the world as that. Unless I saw it I could hardly believe that such things were done.

POWDER AND BLASTING.*

IF we were to accept the best authorities on the measured force of blasting powders and apply the results of their investigations in our work in the same manner that we would accept some well known formula, the results might be different from our expectations. The reason for this is obvious. If it were possible to make a complete examination of the material to be moved or blasted with powder, we might apply our theoretical knowledge but as this is impossible, we must rely greatly on previous experience in the handling of similar material.

The following is from the Encyclopaedia Brittanica, Vol. VIII, Page 812: "Potential energy per pound of explosive substance in foot tons,

Gunpowder	480
Gun Cotton	716
Nitro-glycerine	1,139

"The above figures naturally direct our attention to the small amount of work stored up in even the most violent explosive substance compared with the potential energy of one pound of coal, which is about 4,980 foot tons. Noble and Abel point out that this difference is not alone due to the fact that coal draws its oxygen from the air, but also because the explosive has to expend a considerable amount of work in converting its condensed magazine of oxygen into gas before it can combine with the carbon, further with reference to the economic value of the work done that the oxygen used by the coal costs nothing whereas, much expense is incurred in condensing the oxygen into the explosive substance.

"The practical value of any explosive must depend greatly upon the object to be obtained. It is essential to determine between explosive force and effect.

"Again there are cases even in mining or blasting operations, for instance, where it is desired to displace large masses of earth or soft rock in which a comparatively slow explosive, such as gun-powder, would give better results than guncotton or dynamite. However, speaking generally, gunpowder in some of its forms is far more valuable as propelling agent, while for destructive purposes, the last named substances are much more effective."

It is not the intention of the writer to discuss quarrying and blasting in all its details in this article, but to present two methods of doing the work and the comparative cost. In order to do this, we will consider two methods: first, by means of shallow holes drilled from thhe surface; second, by means of a tunnel, or drift, in which several tons of powder can be placed.

The first effort of the experienced quarryman will be to get what he terms a "face" on the quarry and to avoid a "toe," or at best to keep the "toe" in the quarry "worked up." By the "face" is meant a vertical wall; the "toe" is a small

*From the Proceedings of the Purdue Society of Civil Engineering.

bench or slope of rock left at the foot of the vertical face, and should be blasted or "worked out" before another blast is made from the face, as this triangular toe at the foot of the wall will make the resistance too great at that point. It must be remembered that the force of powder is equal in all directions, and the rock will first be broken in the line of least resistance.

We will suppose we have a face on our quarry 25 feet in height and want to make a blast, or "shot," that will bring down the greatest amount of rock. The character of the rock would in a great measure determine the horizontal distance from the face, that the hole would be drilled. The experience of the quarrymen would be called into use here; he would examine the rock for seams, their direction and width. This would determine both the depth of the hole and the amount of powder to be used. If the rock were granite and what might be termed solid rock, i. e., without seams, it would be safe to go back 15 feet from the face, and drill the hole 20 feet in depth, while it might be safe to go back 20 feet from the face, yet this could only be determined by experiment. If there should be a vertical seam a foot or two in width filled with earth or decomposed rock a short distance back of the hole, the entire force of the powder would probably escape through this soft seam leaving the rock in front of the hole broken, but not thrown out.

But we will suppose the hole to be drilled 15 feet from the face and 20 feet in depth. The next thing to do is to "spring" or make a chamber at the bottom of the hole so it will hold enough powder to throw down the rock. This is done by putting in two to four sticks of giant powder with enough tamping over it to make the powder burn, or "spring," a hole without blowing the tamping out. If in hard rock, this will have to be repeated several times until a chamber has been made that will hold from fifty to seventy-five pounds of powder. If the rock is broken by seams, this will be an easy matter, the only danger being that the rock above the bottom of the drilled hole may lay in horizontal layers, and a part of it may slip forward making a break in the drill hole. Should this happen the work already done may be lost. Sometimes, the first time the hole is "sprung," a seam may open that may make a chamber large enough to hold all the powder required. In any case, the chamber should be below the bottom of the drill hole, and the powder should not be allowed to come up into the drill hole to a height of more than three or four feet. In some cases after the hole has been "sprung" several times the quarrymen may believe the chamber large enough, and when he has put in about one-half powder enough to make a good "shot," finds the powder is coming up into the drill hole; too much has already been put in for a "spring," and too little for a good shot. It may be possible to burn the powder without exploding it. If Judson or other low grade nitro-glycerine compounds are used, this can be done by using a fuse without the giant powder for a detonator. This cannot always be done, and if not possible the half charge must be exploded. If the rock is only loosened it may be possible to put powder into a seam and throw the rock out. In tis event, a nitro-glycerine compound may be used as this need not be so closely confined. In this method of quarrying, we have the following chances for failure and loss:

1. The chance of the drill sticking in the seam before the hole is down the required depth, causing the loss of the hole as far as drilled.

2. The rock shifting in springing and causing a break in the drilled hole.

3. Not being able to make the chamber large enough to hold the requisite amount of powder.

4. To determine the line of least resistance or the direction the rock will be broken so as to be sure the rock will be thrown out and not left in a jumbled, confused mass of hanging rock, that cannot be thrown down with powder.

5. Danger of breaking machinery or appliances for loading or handling rock after being quarried.

Another source of danger is the failure of the fuse igniting the powder, thereby making it necessary to pick out the tamping above the powder so a new fuse can be put in place. This is one of the greatest dangers in quarrying and blasting, as the fuse may fail to burn the entire length, and when the tool used in picking out the tamping comes in contact with the cap on the end of the fuse, it is very apt to explode it causing the entire charge to be exploded.

There is also danger in the powder man trying to load a hole too soon after springing. The rock may be hot enough to explode the powder after it has been in the hole some time. In that case, the powder man might accompany the rock on its way upward.

But we will suppose the entire operation of drilling and loading the hole has been successful; what will be the cost per yard of rock quarried if the powder throws out or down all the rock in front of the drill hole, and at right angles to it for a distance each way equal to its distance from the face?

This would be about as follows: 20 feet in height, 30 feet wide, and 15 feet from the face, or 333 cubic yards.

An estimate of the cost would be about as follows:

Drilling the hole 20 feet in depth	$16.00
Cost of springing the hole and loading	6.55
Sixty pounds of powder at 8c. per pound	4.80
	$27.35

or about 8c. per yard, if everything was favorable. To this must be added 20 per cent for failures and amount of rock less than above estimate.

Another item is the cost of working out the toe that is very apt to be left after each blast, and cost of getting another face for the next shot.

The writer is of the opinion that the majority of quarrymen in reading this would call the estimate too low, and would put it at about 15c. per yard, as nearer the ultimate cost of quarrying, even under favorable conditions.

The second method of quarrying large quantities of rock by means of powder placed in a drift or shaft, is one the writer has employed with the best results. For the purpose of making an estimate of the cost of quarrying by this method a case will be cited that came in his practice. The cost of quarrying porphyry rock to be used in the construction of a dam was so great by the first method that the building of a loose rock dam would have been very expensive. After quarrying about ten thousand yards by the first method mentioned, it was decided to try a drift with powder chambers at the end.

The face of the quarry was about twenty feet in height by 100 feet long. Near the center of this face a drift was driven fifty feet into the hill where it branched forming nearly the letter "Y," the arms of the "Y" being nearly 18 feet in length. At the ends of the "Y" powder chambers were made large enough to hold the amounts of powder decided upon. The right hand chamber was loaded with 4,000 pounds of Judson powder; the left with 8,000 pounds. The difference was owing to presence seams in the rock over the right hand chamber, and the intention being in the future to carry the quarry toward the left. The drift was made 4 feet wide and 5½ to 6 feet high. This size was found the cheapest in hard rock, as it was impossible to use single hand drills. After the drift was finished, the chambers were filled with Judson powder, a low grade nitro-glycerine compound. This powder is about the same in strength as the ordinary black blasting powder, but is quicker in action. The powder was stowed in the chambers as much as possible, with enough loose powder thrown in to fill all interstices. In the center of each chamber was placed a fifty pound box of giant powder, into which the wires leading from the exploding dynamo led. The wires into both chambers were connected so both could be exploded at the same time. A trough made of one inch by four inch pine was laid on the floor of the drift and formed a letter "Y," each arm leading into a powder chamber. When the chambers were half filled with powder, the wires were placed in the trough and led into the box of giant powder. To prevent accident to the wires, the trough was then covered with another piece one inch by four inches. All the wire connections were carefully insulated by wrapping with insulating tape.

For filling or tamping the tunnel, dry sand was used and was simpy thrown in in the easiest way with no attempt at ramming or tamping. When the drift was filled to the mouth the shot was ready for the exploding dynamo, placed about 300 feet back from the face of the quarry and a little to one side. Machinery and derrick standing 300 feet at right angles to the mouth of the drift were not removed as there was no danger from flying rock from the blast.

The best measurement of the amount moved and broken by this blast was made after the rock thrown down had been removed. To enable us to make an estimate for comparison, we will consider the following: the face of the quarry or hillside was about 20 feet in height where the drift started; over the right arm of the "Y," it was 70 feet to the surface, and over the left, 85 feet. After the rock was removed, the measurement of the hole showed that fully 50,000 cubic yards of rock had been moved or loosened so it fell as the loose rock was removed.

The cost of the work was as follows:

86 lineal feet of drift at $7.50 per foot	$645.00
12,000 pounds of powder at 8c. per pound	960.00
Loading and tamping	75.00
	$1,680.00

This would make the cost per cubic yard moved or loosened 3.6c. Part of the 50,000 yards was brought down after the big blast by putting powder in the seams opened by the blast. This, however, did not bring the cost of quarrying to over 5c. per cubic yard.

In quarrying rock by large blasts, the experience of the engineer or quarrymen, must determine, first, the location of drift or shaft and length or depth of same; second, the amount and kind of powder to be used. The writer's observations have led him to believe that it is not well to try to do too much with powder, or in other words that it is better to make two blasts with each tunnel or drift 65 or 70 feet long than one of double that length. In the case mentioned above, the distance from the face to the powder was about 60 feet; the amount of powder used six tons.

In another case when the writer was called upon to consult as to the amount of powder to be used in a drift 117 feet in length, it was decided to use forty tons at the end of the drift, and ten tons about half way from the face, making a total of fifty tons. While the rock was different from the first mentioned case, the amount of rock thrown out for each ton of powder used was less than it would have been with a drift one-half as long.

In the latter case, it would have been impossible to make the two blasts as the rock could not be handled the same as in the first case.

The danger of not using enough powder is greater than using too much. If there are no large seams where the powder can escape there is no danger to property or life from large blasts. When one knows where the powder is, he can tell nearly what it will do. In the case of the hole drilled from the surface and chambered by the use of powder, the location of the powder is all guess work; it may go back from the face or directly toward it. Should the latter happen, look out for flying rock.

Haswell is authority for the following regarding the efficiency of powder in blasting.

"In small blasts one pound of powder will loosen 4½ tons of rock. In large blasts about 2¾ tons."

In the two cases mentioned above the amount in cubic yards per pound of powder used would be as follows: The first case with a drill hole 20 feet in depth, one pound of power would loosen 5.5 tons of rock.

In the second case by a large blast one pound of power would only loosen .31 cubic yards. The relative number of yards per pound of power would be as 31 : 550; the relative cost as 2 : 1.

This apparent contradiction is explained by a glance at the labor account charged to each method; with the small blast the greatest expense is drilling the hole, the powder really being the smallest item. On the other hand, the large blast makes the powder the greatest bill and the cost of the hole or tunnel the smallest item.

The cost of handling rock after it is quarried will be much less where a large amount has been thrown down as machinery can be so placed that it will not have to be moved for several weeks, and possibly months. Another item worthy of consideration is the danger of breaking machinery by small blasts made every day.

This article would be too long if the question of different kinds of powder and different kinds of material to be blasted were discussed. The previous experience of the engineer or quarryman must determine that.

W. S. Russell.

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A STUDY OF PAVING MATERIALS.*

AVING briefly outlined the characteristics of a pavement and assigned them a value, the author proceeded in order to take up these characteristics with reference to the different materials, and apportioned to each its amount according as it approached perfection in each property.

The pavements to be considered are granite blocks laid on 6 inches of concrete with tar and gravel joints, called Granite A; granite blocks laid on sand with joints filled with the same, called Granite B; asphalt wearing surface two inches thick, binder one inch, on six inches of concrete; brick also on a concrete foundation six inches thick with joints filled with pitch or cement; Belgian trap blocks of sand; Macadam eight inches thick, and cobblestone. Wood has not been taken because it is only being used now in some of our western cities, and as laid can only be considered as a substitute for a pavement. It may be said that this is practically true of cobblestone. That may be so, but its use illustrates the scope of the table. This table, according to its present values, is available only in the vicinity of New York City. But the theory of it is correct, and modifications can be made so that it will apply to any section desired.

First cost varies, of course, in each locality, and each material will vary in its percentage as the price varies. Taking the average of the bids received in Brooklyn in 1897, we have:

Granite A	$2.50
Granite B	1.65
Asphalt	1.75
Brick	2.00
Belgian	1.40
Macadam	0.75
Cobblestone	15

all per square yard complete.

Assuming their value to be inversely as their cost, we get Granite A 2, Granite B 4, Asphalt 4, Brick 3, Belgian 5, Macadam 7, and Cobble 14.

It is somewhat difficult to assume any definite period as the life of a pavement. In some cases the amount of traffic determines it entirely. But when a pavement is laid of perishable material like asphalt or wood, while wear will hasten the end, it has a period of life beyond which it cannot go. Assuming the traffic, then, to be normal, the time the different materials should last with ordinary repairs is:

Granite A	25 years.
Granite B	20 years.

*Paper read at Washington Convention of the American Society of Municipal Improvements, October, 1898. By Geo. W. Tilson, Memb. Am. Soc. C. E.

Asphalt	15 years.
Belgian	20 years.
Brick	15 years.
Macadam	8 years.
Cobblestone	15 years.

Figuring as before we have for their percentages:

Granite A	21
Granite B	17
Asphalt	13
Brick	13
Belgian	17
Macadam	7
Cobblestone	15

Some figures already have been given as to the value of having a pavement that is easily cleaned. The street that uniformly presents a smooth and even surface can be cleaned at much less expense than one that is rough and uneven. Working on this principle, Granite A gets 11, Granite B 8, Asphalt 15, Brick 12, Belgian 7, Macadam 5, and Cobble 2.

Many experiments have been made to determine the amount of force necessary to draw a load over different roadways. The results vary greatly, as the attendant conditions are so many that tests canot be expected to agree, except as to general results.

According to the best authorities, the number of pounds required to move a load of one ton at a speed of three miles per hour, the grade being level, is:

Granite A	36
Granite B	45
Asphalt	17
Belgian	38
Macadam	42
Cobblestone	75

Brick must be between Asphalt and Granite A.

This, then, will give a percentage to Granite A of 7, Granite B 5, Asphalt 15, Brick 11, Belgian 5, Macadam 5, and Cobble 3.

The relative slipperiness of the different materials often has been discussed. It varies greatly with condition. For instance, asphalt is more slippery when it is dirty and wet, granite when it is clean and dry. Extended observations were taken in London by William Haywood, Engineer of the Commissioner of Sewers, in 1873, to determine the number of accidents occurring on different pavements. From his results, he deduced that a horse would travel 132 miles on granite, 191 miles on asphalt, and 330 miles on wood without having an accident of any kind. In 1885, Captain, now General, F. V. Greene had a series of observations made in ten of the principal cities of this country for the same purpose. From these, he decided that in the United States a horse would travel on wood 272 miles, on granite 413 miles, and on asphalt 583 miles without an acident. In both of these cases the falls were divided into those upon the knees, the haunches, and complete falls. Falls upon the knees on a rough pavement should

not wholly be charged to slipperiness, as a great many must have been caused by stumbling. Captain Greene found that of a total of 84 falls, 68 were upon the knees. Assuming that one-half of the latter were stumbles only, the deduction would be that a horse would travel 698 miles on granite without an accident due to slipperiness. These results, of course, are general. From these and other observations, Granite A is given 6, Granite B 5, Asphalt 3, Brick 6, Belgian 4, Macadam 7, and Cobble 5.

The cost of maintenance of pavements varies greatly in different cities. It is governed principally by the character of the material, amount of traffic, and the condition in which the streets are kept. What is good repair in one city would not be allowed in another. The records on this subject are very meagre. Systems vary in all places, and not much attention is paid to the cost of any particular street. Granite well laid requires very little repairing. Asphalt has generally been repaired by contract after the expiration of a five year's guarantee. Some cities pay a price per yard for the entire street; some pay for the actual quantity of new pavement, and others for the amount of material used. Under ordinary traffic, the repairs should not cost more than six cents per yard per annum. Brick has not been in use long enough to obtain reliable information upon its cost of maintenance. In this paper it has been assumed to be the same as asphalt. Belgian block requires but little repairing, as it is hard and well resists the action of travel. The cost of maintaining Macadam is great and variable. The reports of the city of Glasgow, Scotland, show that the total cost of Macadam repairs for the years ending May 31st, 1896 and 1897, was ten cents per yard, and in London they sometimes reach sixty cents per yard, and in Paris forty-four cents. In Nashville, Tenn., the stone used is so soft that the streets often require resurfacing several times a year. Traffic tells very quickly on this kind of a pavement. The values allowed are Granite A 10, Granite B 7, Asphalt 6, Brick 6, Belgian 7, Macadam 3, Cobble 2.

Probably no figures can be found upon which to base a calculation for favorable to travel. Yet, the saving to livery men, firms and corporations employing many teams must be great when poor pavements are replaced with good. Stone pavements are very severe upon both horses and vehicles, especially when they are a little out of repair. The allowances are made arbitrarily. Under this head Granite A has 3, Granite B 2, Asphalt 5, Brick 4, Belgian 2, Macadam 5, Cobble 0.

There is a great difference in the sanitary value of the materials in question. Asphalt can be kept absolutely clean; it is impervious to water, free from noise, and has all the requirements of a sanitary pavement. Granite A and Brick have their joints well filled with permanent material and have an even surface. Granite B and Belgian have joints loosely filled with sand, which is soon swept out more or less and replaced with street refuse of all kinds. Decaying as it does, it is offensive and detrimental. A cobblestone pavement never can be kept clean. To make it so would remove all the earth that maintains the stones in place. All stone pavements are very noisy, and so are illy fitted for street near hospitals, schoolhouses, churches or similar buildings. There is no doubt but that the noise from stone pavements contributes largely toward all nervous disorders. Macadam

is extremely dusty, absorbs moisture of all kinds, and is hardly to be considered for a city street, though it ranks high in some respects. In the old City of New York the number of deaths from all causes in 1892 was 44,329; 1893, 44,486; 1894, 41,175; 1895, 43,420; 1896, 41,622; and in 1897, 38,877; showing an absolute decrease in that period of 5,452, despite a large increase in population. This is a remarkable record. It is accounted for by increased sanitary measures in general, and largely to the laying of asphalt pavements on the east side, where the population is larger per acre than in any city in the world. The streets have been kept clean, and they are, in a measure, the recreation grounds of the people. As a sanitary pavement, then, Granite A receives 9, Granite B 7, Asphalt 13, Brick 10, Belgian 5, Macadam 5, and Cobble 2.

The table can now be completed. By summing up the values under each head, the true worth of each material is obtained, and by comparing these totals with each other, we arrive at their relative rank:

	Percentage.	Granite A.	Granite B.	Asphalt.	Brick.	Belgian.	Macadam.	Cobblestone.
Cheap	14	2	4	4	6	5	7	14
Durable	21	21	17	13	15	17	7	15
Easily cleaded	15	11	8	15	12	7	5	2
Light resistance to traffic	15	7	2	15	11	5	5	3
Not slippery	7	6	5	3	6	4	7	5
Cheaply maintained	10	10	7	6	6	7	3	2
Favorable to travel	5	3	2	5	4	2	5	..
Sanitary	13	9	7	13	10	5	5	2
Totals	100	69	95	74	55	52	34	45

Having constructed the table, it will now be in order to illustrate its use: Assume, for instance, a street over which the traffic must be great and continuous, ultimate cost is of great importance. It ove rules first cost. Light resistance to traffic and also foothold for horses, ruling elements, so that any power may draw the maximum load. The items first to be studied, then, are: Durability, maintenance, traction, and the not slippery property. Consulting the table and combining the values for these items, Granite A has 44, Granite B 34, Asphalt 37, Brick 36, Belgian 33, Macadam 22, and Cobble 25. Granite A has such a decided lead over the other that it would hardly be necessary to make a further examination before coming to a decision, but when the figures are as close as the next four, ranging from 37 to 33, a careful study of the remaining qualities would be required. In this particular instance Granite A stands so near the top on the totals and so far ahead in the special requisites, it would seem that no mistake could be made in selecting it as the material to be used.

Consider next a residential street built up with homes, whose owners have means sufficient to afford the best of anything they desire, and while not wishing to be extravagant, they do want and expect to have the best pavement that can be laid without regard to expense.

This is a different proposition. First cost, durability, and maintenance, of the

utmost importance before, can be left out entirely. Easily cleaned, not slippery, favorable to travel, and sanitary are the governing characteristics. Now, Granite A has 29, Granite B 22, Asphalt 36, Brick 32, Belgian 18, Macadam 22, and Cobble 9. Asphalt possessing all the desired properties in so high a degree should be selected without question. It may be said that durability and maintenance are too hastily disposed of, and that by considering them the results would be changed. But here is the point of the whole argument: The property owners can afford the best. They would not carpet their drawing-rooms with hemp matting, because it would last longer than tapestry, nor furnish their dining-room table with crockery and pewter, rather than with china and silver. The idea is the best material under required conditions. The above conclusions would generally hold good for the best retail business streets.

Now let us take a residence street with a very light traffic, where the abuttors wish a good but an economical pavement, one that will be durable and as near first-class as their pocket-books will admit. This requires careful consideration. The destructive action of travel is almost eliminated; durability will be governed by the action of the elements. Every quality but light resistance to traffic must be taken into account. This gives Granite A 62, Granite B 50, Asphalt 59, Brick 54, Belgian 47, Macadam 39, and Cobble 40. Granite A leads, but it gets its supremacy from its great durability under traffic, a property that is not required here. Leaving this out, there remain Granite A 41, Granite B 33, Asphalt 46, Brick 41, Belgian 30, Macadam 32 and Cobble 25. All but the three leading materials can now be eliminated, leaving for further consideration Granite A, Asphalt, and Brick. Now, while durability has been left out, its value has been determined by the action of traffic and weather. In this case, action of traffic is left out, and when it is considered that asphalt has a life that is determined by climatic conditions, irrespective of condition of traffic, it will be seen that in such a case as this Granite A and Brick can consistently be placed above it. These two materials now stand at the same value, 41, but by examining the table it will be seen that Granite A gains four points over Brick on maintenance, simply on account of its superiority under heavy travel. Leaving that out of our total, Granite A has 31 and Brick 35; and this is plainly the proper material for the street.

If the property owners, however, think the price too high, and prefer granite with its inconveniences to the more pleasing brick, then Granite B would be the choice. But it must be understood that money casts the deciding vote.

Assume that a country highway is to be improved where the traffic is not heavy, but the road is needed to facilitate the intercourse between towns, or to connect a suburban village with the parent city, Sanitation, Easily Cleaned, Durability (except as to action of weather) and Light Resistance to Traffic can be eliminated—Sanitation and Easily Cleaned, because on a sparsely settled road matters are unimportant that could not be allowed in a city; the other qualities because no heavy loads will be attempted. There will remain then, Granite A 21, Granite B 18, Asphalt 18, Brick 19, Belgian 18, Macadam 22, Cobble 21. Here the values are more nearly alike, but the cost of the first five materials will rule them out, when there can be no question between macadam and cobble on account of the undesirability of the latter, even though the former has but one point

in its favor. By modifying the foundation for brick under these conditions, it would very likely make a good showing, and in many localities prove the proper material.

The above ilustrates the workings of the table, and while there are many imperfections in it, as much of it has been settled arbitrarily by the author, and allowance must be made for the personal equation, it does seem, to him, at least, that it is a step in the right direction; that it is getting away from gilttering generalities, establishing plain figures for certain elements that have not been valued in exact terms before, so that they can be understood and of service to those wishing information. If this attempt brings forth discussion here at the present time or later in other circles sufficient to place these figures at their true value, the author will feel fully repaid for the labor expended upon this attempt.

PRACTICAL STONE-CUTTING.—XV.

DIRECTIONS FOR FORMING THE RAIL OR COPING, THE PLAN, PROJECTION OF PATTERNS, ETC., FOR WHICH ARE EXPLAINED AT PLATE 13.

WE may assume the student to have followed the directions given at the preceding plate, and to have projected and designated the necessary patterns, and selected a stone of the required size corresponding to that given in Figs. 2-3 of the preceding plate, this done we may proceed to cut the stone.

For the benfit of the beginners we have in the explanations given below assumed the coping to be formed from a "rough stone," that is, cut entirely by hand without the aid of machinery, of course in practice machinery may be advantageously employed, the "saw" or "planer" in forming the top and side, the first planes of operation, and the "Rip" in cutting the two joint surfaces, and in cutting off the corners at the convex face.

FIRST WORK: Fig. 1. At the top side of the rough prism roughly form a plane surface, a "tooth-chiseled" surface will answer the purpose. Upon this mark the bed mould transferring the joint lines 1-6, 4-5 which belong to the top surface. Now to the direction given by the lines in question cut "drafts" making them perfectly straight and "out of wind." Then at the edge A-X cut a draft to coincide with those just cut, on this mark a hard line A-X of Fig 1, this line corresponds to the line 6-7 parallel with Z-8 of Fig. 3, Plate 13, and requires to be drawn in such a position that the side A-X-w-k of the prism may be made "square" with the top plane of operation. The reason of this will be seen on an inspecton of the drawngs of Plate 13, for it may be noted that the arris 6-6 of the lower joint is at right angles with the top surface, and the point W of the upper joint also meets the side in question. This understood mark again upon the top surface the joint lines and curves of the bed mould, at this application the directing level ordinate Y-Y of the mould (represented in the line O-E of Fig 1) requires to be placed at right angles with the line A-X. This will bring the points 6-X of the mould exactly over the line A-X.

Now to cut the lower joint surface: Take Bevel No. 1 and as shown in Fig. 1 applying the blade on or parallel with the line A-X, then from the point given in A mark the line A-k. To the direction given by this line and that of the joint line A-D roughly form a plane surface. Now take a square and placing the blade on the line A-e parallel with the line O-E, in this position mark upon the surface just cut the line A-k, and to its direction cut a small draft as shown in the diagram. After this has been cut again apply the Bevel No. 1 and upon the draft mark to its direction the hard line A-k, this together with the joint line A-D gives the proper direction at which to form the plane surface of the joint. Having cut

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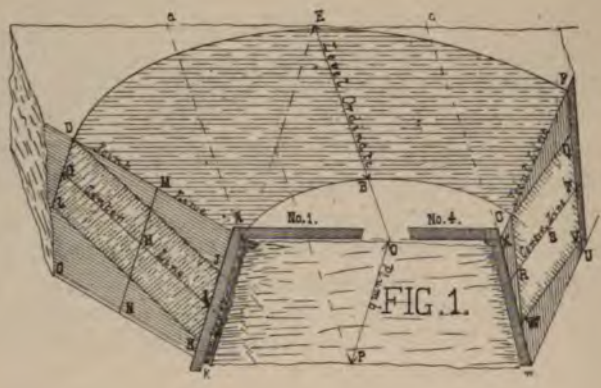

FIG. 1.

FIG. 4.

FIG. 5.

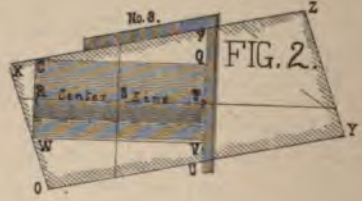

FIG. 2.

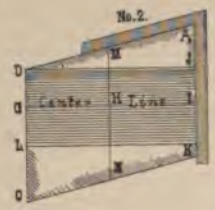

FIG. 3.

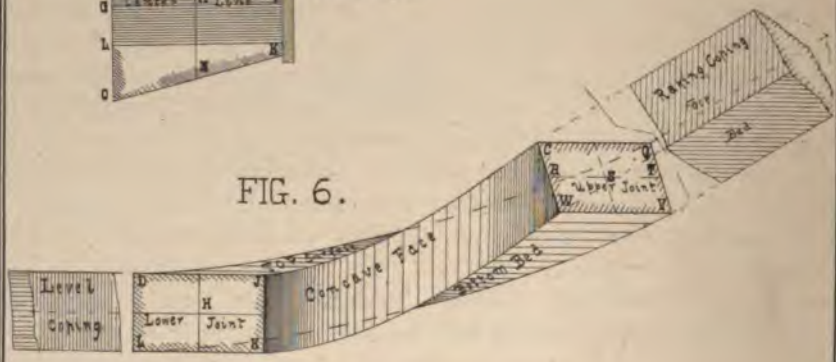

FIG. 6.

PLATE. 14.

this, take the Bevel No. 2 applying it as shown in Fig. 3 so that it coincides with the point given in A of the bed mould, and draw the line A-K. If the work described above has been properly done the bevel will coincide with the arris formed at the junction of the drafts, that upon the side, and that upon the surface of the joint. Now square with A-K draw D-J, this gives the cutting line which forms the arris of the top surface of the coping, to its direction mark the joint mould which will complete the work required at the joint. In the same manner making use of the Bevels Nos. 4-3 together with the square, may the plane surface of the upper joint be formed. Now rough off the lower surface to the thickness required, of course making the prism of a uniform thickness, on this surface mark the bed mould, the points given in K-U are those to which the mould may be applied. Then cut the concave and convex faces of the coping. In cutting these the straight-edge may be applied to lines parallel with the arris's D-L, at the convex, and A-K at the concave face, obtaining in this manner the direction at which to cut the "plumb drafts."

Now take the face moulds that of Fig. 4 for the convex, and that of Fig 5, Plate 13, for the concave face; the points given in D-L-O-U are those to which the former, and the points given in J-K-W-X are those to which the latter mould may be applied. We now obtain the direction for forming the twisted surfaces at the top and under sides of the coping, by applying the straight edge to the radial points given at the moulds, that is, to the verticals made use of in developing the moulds in question, the proper direction may be obtained for cutting the twisted surfaces.

If the coping or rail be "Moulded" trammel at the surfaces the cutting lines of the several sinkings, in the manner any form of circular moulding may be worked and so bring the stone to the section desired.

Chas. H. Fox.

STONE CHANNELING.*

ONE of the most valuable applications of machinery to the quarrying of stone is to be found in the channeling machine, which is now very generally used in quarries producing marble, sandstone, lime-stone, serpentine, slate, and some of the granites for building or ornamental purposes.

When the rock is stratified in layers of different thicknesses, or when it varies in character, the channeling machine is especially valuable, as a number of working places may be kept open at different levels, and the rock taken from any desired part of the quarry for filling orders as they come in for the various qualities, colors or thicknesses produced.

It is not advisable or necessary to get the rock out by cutting all the vertical sides of a dimension block free from the ledge, as ice is harvested, for instance. The work should be arranged so as to do as little of it as possible, merely cutting the rock in long strips; the distance apart of the channels must be decided by the breaking or cleavage qualities of the stone. In other words, the best application of the channeling system is in the cutting of the rock into large detached blocks, the working it down to the desired size being done with the Githens System of blasting, with plugs and feathers, or with wedges, as maybe best suited to the purpose, as it is evident that stone can be divided more cheaply with powder or wedging than by channeling.

In making an opening into a sheet, or in deepening the quarry, three vertical sides are channeled to the desired depth of the bench. Two nearly parallel cuts are then made through the center of the mass, converging slightly to the ends farthest from the most convenient derrick. The key block is then removed, and the quarrying resumed in the regular way, working in one or both directions, from the centre cut.

A channeling machine, when handled by a competent man, will save its cost from two to six months, and will in many cases reduce the cost of quarrying fully one-half, and in most cases at least one-third. The stone is brought out in marketable shape, and there is little or no waste to go to the dump. It is poor economy to dispense with the use of a channeler because of its cost. In opening quarries it should be one of the first things purchased.

There is the advantage of being able to calculate how much stone can be got out in a given time, and the stone comes out in such desirable shape that it finds a ready market. The capacity of the quarry is largely increased with the same force of men. The quarry floor can be enlarged, and would otherwise grow smaller as the quarry became deeper.

In some thin-bedded lime-stone quarries, working mainly for curbing, cross-

*From the Ingersoll-Sergeant Drill Co.'s Catalogue, No. 41.

ings, etc., long channels can be put down through a number of different sheets, from 18 in. to 24 in. apart, each channel cut leaving two smoothly-dressed faces of stone ready for the market at far less cost than by hand-dressing.

It does not pay to quarry granite by the channeling process. It is possible to cut granite successfully with reciprocating chisels, but the work is slow and expensive; hence, granite quarries which have no free beds are not profitable investments. A limited amount of channeling is done in most granite quarries, but it is confined to the walls, sumps, key blocks, etc.

The cheapest and best machine for channeling granite is a rock drill of large size, say $3\frac{1}{2}$ in. or $4\frac{1}{2}$ in., mounted on a straight quarry bar; the work being done by broaching.

Channels, as usually made with the regular channeler, are from 4 ft. to 7 ft. in depth though they are in some cases cut 16 ft. deep, or more. In the marbles and limestones the cut is usually $1\frac{1}{8}$ in. wide and from 30 ft. to 50 ft. long at each setting of the track, but in the grit sandstone the cuts are started wider, and as a usual thing, are shorter than cuts made in stones where grit is absent. Frequent "reaming" is necessary in gritty rock to prevent the cut getting too narrow.

The cost per square foot channeled and per cubic foot of rock put on the market varies, depending on the hardness and solidity of the rock, skill of the operator, depth of the cut, etc., speaking generally, one machine can cut in soft sandstone about 175 square feet per day, at a cost of about $3\frac{1}{2}$c. per square foot. If the channels are 13 feet apart, each square foot channeled will release 13 cubic feet of rock.

In the hard brownstones and sandstones a machine can average 75 ft. per day, at the cost of about 9c. per square foot.

In some of the Lake Superior brownstones, 200 square feet is a fair average, at a cost of about 4c. per square foot.

In oolitic limestone 250 ft. is the usual average, at a cost of about $2\frac{1}{2}$c. per square foot.

In marble, from 75 to 150 square feet can be cut, at a cost of about 10c. per square foot.

The figures are conservative and are based on actual monthly averages. Daily records are frequently made much higher than given; for instance, our machines have cut 475 square feet in 10 hours in limestone, but daily records are misleading.

As the amount of work done and its cost depend so much on the skill and energy of the machine runner, the importance of having only the most intelligent class of men in charge of such expensive and valuable labor-saving machinery will be apparent to all operators of experience.

Slate can also be channeled successfully and economically.

THE CLASSIFICATION OF BUILDING STONE.

The majority of stones used for any form of structural or decorative work may be roughly classified under three heads. The crystalline, siliceous rocks, which include the granites; the calcareous rocks, including all limestones and dolomites; and the plastic rocks, including the sandstones and clay slates. Those of the first group have been formed from molten matter, erupted from the earth's interior or from the metamorphism of siliceous sediments; the origin of the second group is deposits of calcareous mud from the breaking up of shells, corals, and the remains of other marine animals on an old sea bottom; those of the third group result from the breaking up of older rocks, and the accumulation on the bottom of lakes and seas of the resultant sand, clay, or mud, in beds of varying thicknesses, to be subsequently gradually hardened into stone.

The essential difference between a marble and a compact common limestone, is that the first has undergone, through the combined action of heat and pressure, just the right degree of change, or metamorphism, to develop in it crystallization and color. The essential difference between a brick or fire clay, and a cleavable slate used for roofing, is that the first named still retains its plastic condition as it was laid down in the form of fine silt on a sea bottom, while the slate has, by geological agencies, and by actual movements of the earth's crust, been so squeezed and compressed as to lose all resemblance to its former self, and to become the cleavable article of commerce we now find it.

Since these processes of change are dependent very largely upon the actual movements, warpings and foldings, as may be said, of the earth's crust, and the heat and chemical action which is thereby generated, and since these movements only take place with extreme slowness, whole geologic ages being occupied in their conception and completion, it follows, as a matter of course, that metamorphic rocks, like granites, marbles, and slates, are found only among the older rocks, and only in those portions of the country where this crust has been wrapped, compressed, and folded, as in the process of mountain making. In other words these rocks are to be expected in their best development only in places bordering along more or less extensive mountain ranges.

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APPENDIX AND FOUNDATIONS.

CEMENTS AND LIMES.

nt Melan Concrete Arch Bridges.

LAN concrete arch bridges were last summer erected for Mr. Fred. W. Vanderbilt on his private estate de-Park-on-the-Hudson, eight miles of Poughkeepsie, N.Y. While only ls. apart, the scenery at the two lo- s required very different artistic ient to harmonize the structures heir surroundings.

Vanderbilt, after extended investi- finally selected the Melan system ncrete-steel arch construction, not n account of its lower cost with permanence as compared with voussoir, stone arches, but also because of the ready adaptation of this style of construction to the varying architectural treatment required in different locations.

The structure shown in Fig. 1 with natural surroundings, was faced with unhewn field stone and boulders. It consists of two spans, 53 ft. and 26 ft. in the clear, respectively, and each 7.5 ft. rise, and is 17 ft. wide. The longer arch springs from the rock cliff to the pier and its concrete ring is 10 ins. thick at the crown, and 30 ins. near the springing line, and at right angles to the intrados,

FIG. 1. THE MELAN CONCRETE ARCH, WITH FIEND STONE FACING.

embedding five 7-in steel I-beams bent to the curve of the arch. The shorter span springs from the pier to an abutment founded on a hard strata of gravel and clay. Its concrete ring is 8 ins. thick at the crown and 20 ins. near the springing lines, at right angles to the intrados, with five 5-in steel I-beams, bent to the curve of the arch, embedded therein. The centers for this bridge were designed to suit the local circumstances.

The bridge shown in Fig. 2, being in a more improved part of the grounds, a point 22.5 ft. from the center, and more rapidly from there to the abutments. Embedded in the arch ring are seven 9-in. steel I-beams characteristic of the Melan system, as shown in plan and sections.

One abutment is founded on solid rock, the other on reasonably hard strata of clay and gravel. The concrete in the abutments, spandrel and wing walls was proportioned 1 part Portland cement, 3 parts sand and 6 parts broken stone; near the springing lines of the arch the

FIG. 2. THE MELAN CONCRETE ARCH, WITH MOLDED CONCRETE FINISH.

was given a more elaborate architectural treatment, all exposed surfaces being moulded in Portland cement mortar. It has a clear span of 75 ft., with a rise of 14 ft. 8 ins., and a clear roadway of 16 ft., the total width of arch being 20 ft. The intrados is a curve of five centers. The wing walls on the four corners are curved outwards to give better approaches to the bridge and more easy and graceful connections with the driveways. The concrete arch ring is 15 ins. thick at the crown, increasing slowly towards the springing lines to a thickness of 21 ins. at proportions were gradually changed to those used in the arch ring, which were 1 Portland cement, 2 sand and 4 broken stone. After the completion of the abutments the concreting of the arch was started simultaneously from both sides to the full width of the bridge, and work was continued day and night until the arch ring was completed and the spandrel walls carreied up to the copings and expansion joints, in order to make the work monolithic and to avoid all signs of demarkation in connecting old with new concrete. Each of the four wing walls

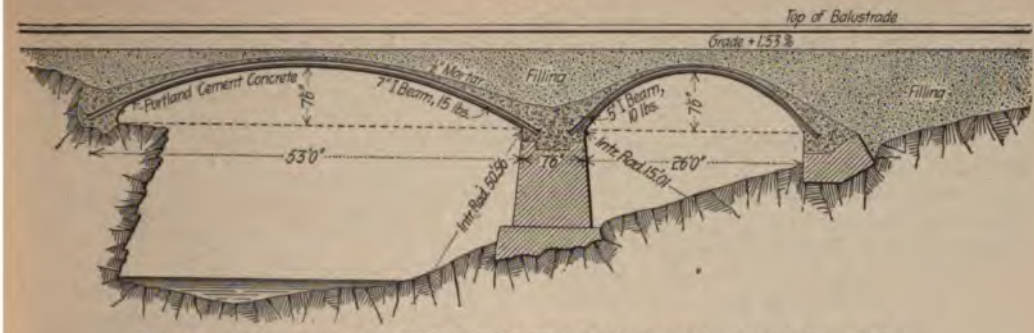

FIG. 3. LONGITUDINAL SECTION OF TWO-SPAN MELAN CONCRETE ARCH.

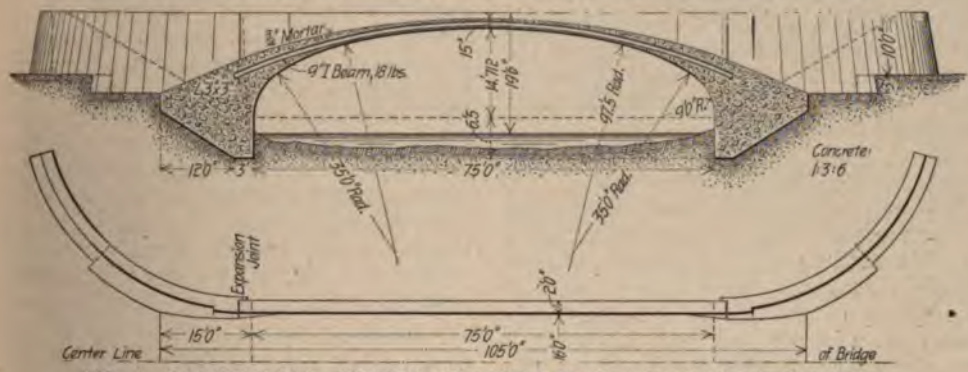

FIG. 4. LOTGITUDINAL SECTION OF SINGLE-SPAN MELAN CONCRETE ARCH.

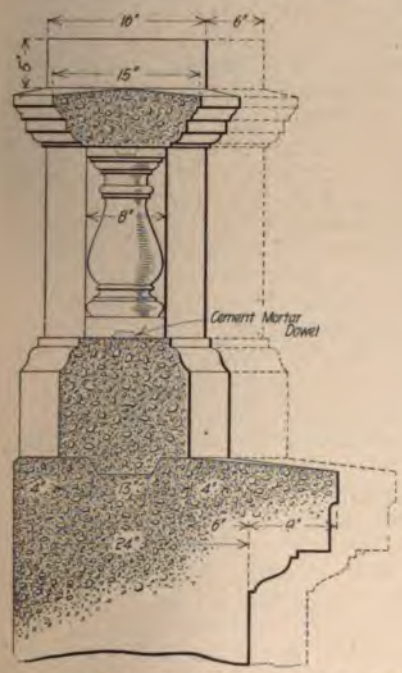

FIG. 5. DETAIL CROSS SECTION OF BALUSTRADE FOR SINGLE-SPAN ARCH.

were then carried up as continuous work for the same reason, and expansion joints were provided between spandrel and wing walls to facilitate the free action of the arch under varying temperatures. The entire face finish is in concrete, as is also the balustrade. In all exposed faces, for a thickness of about 1½-in., mortar was used without the broken stone, but in all cases deposited at the same time as the concrete backing. In order to get a very fine finish, the lagging of the centers and all molds for spandrel and wing walls were neatly covered on the inside with a thin coat of plaster, which was oiled before any concrete was deposited.

The centers of this bridge were constructed to rest on two old piers, which were afterwards removed. The base of the balustrades and the posts were molded in place, but the balusters and top rails were molded or cast in iron or wooden forms, and afterwards set in place exactly as would be done with cut

stone. In all parts of the balustrades, concrete, 1 to 2½ to 5, was used, except near the faces where the mortar was without stone.

Mannheimer Portland cement was employed in the two-span bridge, and in the abutments of the single span bridge; and Germania Portland cement for all the remainder of the latter, including the railing. Both bridges were designed and superintended during erection by the Melan Arch Construction Co., 35 Nassau St., New York City, who are also the owners of the U. S. Patents covering the Melan arch construction, to whom we are indebted for the use of the ilustrations in this article, originally published in Engineering News.

The Properties of Lime.

Though lime, in its many forms, is one of the most ordinary substances met with on this earth, yet the essential element which goes to the composition of lime is not by any means a familiar body. As is well known to everyone who has learned any chemistry, lime is the result of the union between oxygen gas and the metal calcium. This very remarkable element, calcium, is, however, never found in nature unless in such intimate chemical union with some other element like oxygen or chlorine that the characteristic properties of the metal are disguised. To see calcium itself you must go to the chemical laboratory, where by ingenious process the shy element is temporarily divorced from the union with the oxygen or other body for which it has so eager an affinity.

Though most of us have never seen a particle of calcium it may well be doubted whether there is any element more important to the economy of this earth or more widely distributed over it. Calcium abounds in every soil. Calcium is in the waters of the sea. The cup of spring water owes much of its invigorating freshness to the calcium which it holds in solution. The white cliffs which have given the name of Albion are but one of the many forms of calcium.

Try to imagine what this earth would be like if calcium were withdrawn. The birds could not lay eggs. The sea could produce no shells. Man and other animals would need to have bones very different from those which they at present possess. Buildings would in great part vanish. Even the hills and mountains would to a considerable extent disappear. Probably a very large part of the total mass of this earth would be taken away if all the calcium were to be removed.

Without calcium a world inhabited in the same manner as our present abode would be clearly impossible. There are, it may be, lowly organisms, on this earth to which calcium is apparently of no appreciable consequence, and it is conceivable that a world of living types of some kind could be constructed without the aid of that particular element which is generally so indispensable on our globe, such a world would be totally different from that world which we know. Under present conditions the significance and importance of calcium in our economy can hardly be overestimated.

Attention has been drawn to the importance of calcium on the earth; we have now to add that this same element appears to be most widely distributed among the various bodies in the universe. Among the most remarkable features in the photographic spectrum of the sun are two very broad and very dark and very conspicuous lines. In every photograph of the ultra violet light of the sun these lines stand forth so boldly as to arrest attention more than any other feature of the spectrum. It had been known that these lines were due to calcium, but there were certain difficulties connected with their interpretation. Some recent researches by Sir William and Lady Huggins have cleared away all doubts. It is now certain that the presence of these lines in a spectrum demonstrates that the remarkable element which enters into the composition of lime on this earth is also in the sun. These same lines have, indeed, been detected in the photographic spectrum of many other bodies. Thus the interesting fact is established that this particular element which plays a part so remarkable on our earth is not peculiar to our globe, but that it is diffused far and wide throughout the universe.—Humanitarian.

Greater New York's Trade in Concrete.

The largely increased use of concrete masses in foundations in place of masonry masses, such as brick or stone, has resulted in a tremendous development of this industry, which is largely augmented also by the use of concrete on bridges, buildings and in an innumerable variety of ways. Concrete is, in fact, now used in almost every way that stone was formerly applied. The use of concrete by the Government for fortifications has practically exhausted the cement market. In every department of engineering along the seacoast the requisitions for this material have been and continue to be enormous, and there is no likelihood of a decrease in the demand, as the establishment of naval stations at Porto Rico and other recent American possessions will call for large additional quantities. The use of concrete in fireproofing, which was little known a few years ago, has also developed extensively, as its advantages in this direction are now recognized by engineers and architects.

There are half a dozen firms in New York which make a specialty of fireproof construction by means of concrete. Something like $20,000 was spent in this city two years ago in tests of various fireproof materials, and in no instance did concrete fail to meet the requirements.

The enormous growth of the concrete business has carried the cement industry beyond its limits, and the largest cement company in New York is now engaged in an effort to double its capacity. Several new plants are also being built in places contiguous to this city. New York capital is likewise largely interested in the quarries east of the Alleghanies, from which the stone used in cement is obtained. The demand for foreign cements was lessened temporarily after the introduction of the new tariff on account of its advanced price, but so great has the concrete business grown that at present manufacturers here are glad to take all of the imported cement they can get. This article, however, is likewise not obtainable in sufficient quantities to meet the demand, for the advantages of concrete have been recognized simultaneously on the other side, and the manufacturers there make exhaustive demands on the cement factories. The use of concrete is to be by no means a temporary one. Everywhere its usefulness and value are being demonstrated, and as a more general knowledge of the material is disseminated the demand for it will undoubtedly increase.—New York Tribune.

The 1899 Michele Test for Cement.

Mr. V. de Michele, of Rochester, has published the following 1899 "Michele Test" for Portland cement: Pats ⅛in. thick in water, to be absolutely sound at seven days; tensile strength, 400 lb per square inch at seven days; and 450 lb per square inch at fourteen days. Fineness, 15 per cent residue on a 100 sieve. The pats to be gauged on glass, immersed in water immediately, and left there for the whole period. One pat to each three bricks. The test bricks to be gauged by a skilled man, with a minimum quantity of water, and well rammed into moulds. The average of three to be taken, which shall represent about 100 tons or less. The strain to be applied as quickly as possible. The sieve to have 10,000 holes per square inch, and to be of wire not less than .004 in. (42 S. W. G.) in diameter. Shaking to be continued for five minutes.

The Color of Natural Cement.

The color of the manufactured cement, being due principally to the presence of a small quantity of oxide of iron and sometimes of manganese, or to the carbonates of these oxides, which for all practical purposes are conceded to be a passive ingredient in hydraulic mortar, should be a matter of indifference to consumers. In fact, the presence of a large proportion of the coloring principle, like that of any other inert substance, might be expected to have a tendency to deteriorate the quality of the mortar by diminishing the cohesive strength of the cementing substance, and, therefore, if taken into consideration at all, at least to direct suspicion to the darker varieties.—Gen. Q. A. Gilmore.

"Woodine."

"Woodine is the name given to a composition for making flexible moulds for casting Portland cement in high relief," says the Architect, London. Hitherto it has not been possible to make satisfactory castings owing to the rapid shrinkage which takes place in the usual mould made of gelatine, and also to the action of acids in the cement destroying the face of the moulds. With "Woodine," however these objections do not arise, as the moulds made with this material remain unaltered for weeks. We have inspected some that have been in existence for three months, and the decrease was so slight as to be of very little consequence. From these moulds some dozens of casts have been made. It is hardly necessary to point out the many uses to which Portland cement cast in high relief may be adapted, both for the enrichment of the exterior and interior of buildings. We are informed that eight pilasters, each weighing 1½ cwt., and being 6 feet long with moulded base and carved capitals, have been made from one "Woodine" mould, and that if necessary four casts per day for a month could have been taken without spoiling the mould. There can be no doubt that "Woodine" moulds are more durable, tougher and yet more flexible, and are in every way superior to those made of gelatine, and after use may be remelted several times.

CEMENT TRADE ITEMS.

New York.—A company, the Uvalde Asphalt Co., has been incorporated to develop a new asphalt substance called litteo carbon. The incorporators are New Yorkers, and the company has a capital of $30,000.

Contracts have been let by the Michigan Portland Cement Company for building two big additions to their factory at Coldwater, Mich., and seven more rotaries have been ordered. This will increase the capacity of the works to 1,500 barrels per day. Work on the Quincy factory, to be built by the company, begins in January.

The proposition to form a cement trust in southern Indiana, all the mills to sell their produce through a Louisville, Ky., agency, is said to have been abandoned.

It is reported that the marl beds at Clarendon, N. Y., cover 400 acres and the deposits reach, in some places, ten feet in depth, and will produce 1,000 barrels of cement daily for a century or more.

Canton, O.—Samuel J. Immel has sued the Diamond Portland Cement Company to recover damages amounting to $20,000. The plaintiff claims that on June 16, 1898, he was engaged in cutting away a timber which obstructed the passage of a conveyer used by the company. While he was thus engaged the conveyor was started without notice being given him and his left leg and back were badly crushed, the injuries inflicted being permanent.

The marl beds near Mosherville, Mich., have been examined by a party composed of Messrs. F. M. Stewart, T. M. Fant, Dr. W. H. Sawyer, Geo. D. Harding and C. F. Stewart, of Hillsdale; Israel Wicks, of Jonesville; Messrs Jordan, Byres and Beebe, of Jackson, and Mr. Buntz, of Bronson. The gentlemen were very favorably impressed with the outlook for the establishment of a plant for the manufacture of the marl into Portland cement.

The project on the part of the lime manufacturers of Ohio and Indiana to form a combine has fallen through. A meeting for that purpose was held at Ft. Wayne and the plans of organization were discussed. The men who were at the head of the scheme laid out their plans which were then discussed. All the men at the meeting were in favor of the move with the exception of L. McCullom of Tiffin. He expressed himself as being opposed to it, and as it was impossible for the combine to be formed without his becoming a member, the project had to be dropped.

MARBLE AND GRANITE

The Vermont Marble Industry.*

QUARRYING was carried on in Pittsford quite early, not so early as at Dorset. The oldest quarry was opened in 1795. According to Professor Seely, in the "Marble Border," there are three beds of Marble in Pittsford, extending north and south. "The most easterly of these has a breadth of about 200 feet, and on it was opened, in 1871; the quarry known as the Central Vermont quarry. It was successful until the great depression of 1874, from which it has not yet rallied. The marble is of the same character as that at Proctor, of which bed it is probably a continuation. The middle bed is separated from this easterly one by about 200 feet of lime rock. This bed is itself 400 feet wide and contains marble of different shades, from pure white to dark blue. Buildings made of this marble have stood the test of years. * * * The third or west bed, thought to correspond to that of West Rutland, is about half a mile west of the Central and abuts on the west against the slate, this having disappeared from the region east of it. This bed, about 400 feet wide, holds beautiful dark blue marble, mottled and veined." In this last named bed there are two considerable quarries, the Hendee, worked by the Vermont Marble Company, and the Florentine, the stone from which is sawed at Belden's Falls.

North of Pittsford I found no quarries in operation until reaching Brandon, where there are at present two, besides several not worked. I was told that the Corona quarry, still farther north, was also worked.

About two and one-half miles southwest of Brandon station is the Bardillo quarry and mill. Here there is a peculiarly elegant stone, quite unlike any other that I have seen. The very numerous, strongly-marked, narrow veins which traverse the blocks in sinuous or zig-zag lines, in quite unique fashion, and yet with a certain regularity, make this a very handsome stone. It varies in shade from light to dark gray. The quarry is not large, but the supply seemed to be good and the beds were thick and solid. The quarry was opened, the workmen tell me, in 1882. Most of the product is worked up on the spot into monuments. A much older quarry is that known as Brandon Italian, which is nearer town, being about half a mile below the station. The Bardillo quarry is located on a hillside, and the stone is quarried, thus far without going to any great depth. This other quarry is much deeper, and is peculiarly long and narrow. The beds are thick; at the time of my visit the channeling machine was cutting out a bed 6 ft. 8 in. in thickness. The mill which had been operated at the quarry burned last winter and the company are building a new one at Middlebury, to which place the blocks will hereafter be taken to be worked up. This marble is solid, and light colored, that is, white with dark veins.

There were formerly several quarries in Middlebury, but none are now worked. I have spoken of the loss which always attends marble quarrying, because of the unsoundness of much that is obtained. Throughout the marble belt marble is ever found near the surface. Hence, when a quarry is opened in a ledge, a greater or less, but always considerable, mass of waste stone, earth, etc., must be removed. For this reason every one who undertakes to open a quarry must

*From last Biennial Report of State Geologist.

spend a considerable sum before he can begin to look for returns. This is well stated in a pamphlet published by the Vermont Marble Company: "A marble deposit being found, it is first bored, and with a machine constructed for the purpose, a solid core is taken out, from which the quality of the marble is easily determined. The soundness, however, can only be proved by opening; and the opening of a marble quarry, unlike granite, is a laborious and expensive operation. From forty to seventy-five thousand dollars has been spent upon several of the West Rutland openings before stock that would even pay to saw has been taken out. The quarry being stripped of the top rock, channeling machines, driven by power, are put on and the entire quarry floor cut into strips, a cut being also made at each end. Small holes at intervals of a few inches are then bored into the bottom of the layer, by means of machines constructed for that purpose, and called gadding machines, and into these holes are driven iron wedges. In this way all of the layer that has been cut is freed from its bed, and it is not unusual to see a strip of rock 50 ft. or more in length raised in this manner. The layer is then in the same way broken into blocks of the size desired, and the marble is hoisted from the quarry to the bank by huge derricks, and if of suitable quality, sent to the mill to be sawed."

Many interesting questions arise as to the origin, age, etc., of the marbles of the region we have been considering. Only very briefly can these be discussed here. As to the origin of these marbles, not of all those kinds of stones sold under the name, but of the marbles in the Rutland district, geologists are agreed that they are metamorphosed limestone. That is, that the ordinary dark, fossiliferous strata, such as we now find transformed into the non-fossiliferous, has been, in the marble region, softened, heated, compressed, crystalized until transformed into the non-fossiliferous, light colored marble. As to the age of these marbles, we may speak with confidence, because of the investigations of a Vermont geologist, who is almost unknown in his own State, the Rev. A. Wing of Whiting, who died about 20 years ago. Mr. Wing, by dint of most careful study of the marbles and ledges of Rutland County, established their age beyond doubt as of the Chazy limestone, one of the lower members of the Ordovician or Lower Silurian. That is, the marble is of the same age as the limestones of the southern portion of Isle la Motte, at Fisk's and Fleury's quarries. Although most of the beds, as those at West Rutland, are of this age, it may be that some are older, and some, as Prof. Seely has suggested, are newer. Chemically, limestone and marble do not very widely differ. Lime carbonate is the chief component of each, but there are some important differences. In the 18th Annual Report of the United States Geological Survey, several analyses of Rutland marble are given. A single example must suffice for the present:

	BLUE MARBLE.	WHITE MARBLE.
Silicate of Alumina	.22	.62
Carbon dioxide	44.00	43.80
Lime	55.15	54.95
Magnesia	.57	.59

The above shows that there is little difference between the dark and the light varieties, in the substances which compose them. In the same report we find the following:

"Vermont is likely to remain in the first place for the production of fine marble for many years to come, in spite of claims of superior product which are occasionally made in connection with new discoveries elsewhere;" and also the statement that the "marble of West Rutland and its vicinity is as yet without a peer in the United States for the finest uses to which marble is applied, and it supplies a large proportion (elsewhere stated as 81 per cent) of the stock used for cemetery work."

Aside from the great quarries and mills with their hundreds of workmen and vast output which have been mentioned, there are in Vermont other quarries which produce marbles of which we may well be proud. The marble quarried on Dorset Mountain has much of it been taken to Manchester to be worked, hence outside of the State it is often called Man-

chester marble. There is no quarry of true marble in Manchester, but there is a quarry of breccia, which was sold as marble, but which is no longer worked because of its unsoundness. It is a very interesting and handsome stone, quite unlike any other in the State. It is composed of fragments, of different sizes, of red, gray, white or brown stone, cemented together by a dark red material. Were it only sound it would be a very attractive stone for interior work.

To be continued.

A Deserted Marble Town.

"Up in Ontario," said J. W. Wheatland, a civil engineer of Montreal, "there is a deserted town called Bridgewater, which is built entirely of marble. About 25 years ago a farmer's wife was searching in the woods for a pig that had strayed from the family pen. In a particularly dense part of the woods she found a spring of crystal water. Being thirsty, she stooped over to drink. As she did so she slipped on a round stone which rolled from under her foot and fell into the water. Attracted by the peculiar color of the stone, she fished it out and took it home. It was found to be a 20 pound nugget of almost pure gold.

"Bridgewater at that time was about 40 miles from the nearest railroad, and the site of the town was a howling wilderness. But such was the effect of the accidental discovery of gold that within six months the wilderness had blossomed into a bustling, substantial city of 5,000 inhabitants and more a-coming. They came from every quarter. There were old forty-niners from the Pacific slope, amateurs from England and the United States, prospectors from every field. Shafts and tunnels were driven by hundreds.

"In sinking a shaft one mile south of the town on the claim of B. Flint, a life senator of Canada, a vein of white marble was found. At the suggestion of Senator Flint, who wanted little or nothing for the material, the town of Bridgewater was built solidly of marble. It has even to this day a court-house, school, church, hotel, stores and private dwellings constructed wholly of white marble. One mile north of the town are an abandoned grist mill and an ax factory whose foundations are built of marble.

"While the town was booming the entire country adjacent was prospected. Some of the shafts and tunnels driven were more than one hundred feet in depth, but, remarkable as it may seem, there was never sufficient gold found by the prospectors collectively to pay the cost of a single mine in the district. Still, the earlier disappointments only increased the virulency of the gold fever, which laid hold of the farmers around Bridgewater with a particularly tenacious grasp. In fact, so excited did they become that many of them actually employed armed guards to prevent trespassers from picking up the loose gold which they imagined existed on their places in vast quantities.

"The place where the original nugget was found by the woman in quest of a pig was christened Aladdin's cave, and land in its vicinity sold for fabulous prices. One farmer whose farm adjoined the cave sold five acres to an English syndicate for $100,000 cash. The syndicate spent another $100,000 in developing the claim, but never obtained a single ounce of free gold. In all it mined about 100 tons of quartz. In return the syndicate received a bill for about $375 smelting charges over and above the value of the gold in the quartz. It was the last shipment of quartz, for the cost of hauling, shipping and smelting was in the neighborhood of $150 a ton more than the rock produced.

"One old Irishman at Bridgewater, Patrick Kehough by name, received an offer of $125,000 cash for his farm, which consisted of 100 acres of rock piled, barren land. He promptly refused the offer, holding out for $150,000, which he never got. To-day one could buy the property for almost anything over $1 an acre.

"Within a couple of years it became patent to all that mining in Bridgewater would never pay. So silently, one by one, the prospectors stole away from their marble residences, to be followed shortly by the owners of the marble stores, leaving the once thrifty town to settle down to a lonely, weed choked and futureless desuetude."—New York Sun.

The First Marble Quarry in Vermont.

The January number of STONE contained an extract from "Vermont Mineral Industry in 1898," by George H. Perkins, state geologist. This statement is made in the article: "The oldest quarry known is one at Dorset which was opened in 1803." George E. Royce, treasurer and manager of the True Blue Marble company, whose quarry is at West Rutland, was asked about this statement, and he said:—

"I would say that without any doubt the first marble quarry opened in Vermont was the property now owned by the True Blue Marble company, and was situated by the side of and underneath the present mill of the company, the farthest north of the line of marble quarries in the town of West Rutland. According to the Rutland town records this quarry was opened in 1785 and was worked continuously in a small way for about 50 years. The record shows that it was described from the beginning as a 'stone quarry, so-called marble.' In 1795 it was sold for £400. In 1812 our member of Congress, Ezra Meech, took a contract to supply a quantity of this marble for a government building in Charleston, S. C. It was hauled with wagons to Troy and shipped by water to New York and to Charleston by vessel.

"Almost all the headstones standing in the cemeteries from Bennington to Burlington dating from 1788 to 1830 came from this one quarry and are almost all in good condition. They were marked before sawing was done, and they were tooled by hand. The quarry was 150 feet long, 125 feet wide and 16 feet deep. The stone taken out was practically surface marble. Now-a-days the marble to the depth of from 15 to 20 feet from the surface is either dumped or only used in work that is not to be finished or polished and is not put into monumental work at all except sometimes it is put into a 'bottom base.' These old headstones are in better condition than the white stones that have been up 25 years, although these blue veins were surface marble, and the white is not more than 20 feet from the surface.

"The so-called father of the Vermont marble industry, William F. Barnes of West Rutland, was a baby when his father owned and was working this old blue quarry, about 100 years ago."

Mr. Royce says that the True Blue Marble company has more orders than it can handle. The force, which numbers about 80, has suffered considerably from the grip.

Carving in Marble.

In the present day carved ornament in marble must be largely affected by considerations of economy. Probably face work, whether sunk or raised, in the majority of cases finds adoption in preference to anything which involves laborious undercutting. Modern carvers frequently fall into the mistake of imitating natural forms closely in foliated ornament. It may be difficult to define the reasons why naturalistic carving is usually offensive to the taste of architectural critics. It may be that there is an agreeable impression of reserve power in the work of the carver who refrains from following Nature closely, while he shows that he possesses the requisite skill to do so. Perhaps, also, the contrast between the stability suggested by architectural forms, and the fragile character of natural foliage, seems inharmonious when both are executed in the same material. Certain it is that the attempted close imitation of natural forms in marble is one of the worst faults committed by monumental sculptors.

The simpliest mode of carving applied to a flat surface is that very largely practiced by modern French architects. It consists in producing scroll-like and other curvilinear forms by means of sunk lines or channels, and is equally applicable to polished or unpolished work. Provided that the sunk lines are cut sufficiently deep in proportion to their width to show as lines of shadow, they become more effective under a strong light than they would be if they were filled up with black cement or mastic. The celebrated "Lily" capitals in St. Mark's, Venice, are examples of the kind of sunk work in which the de-

sign is produced in the sunk portions only, the forms of the intermediate surfaces being left to chance. As it consists entirely of splayed surfaces which catch the light, it is applicable to polished marble, and is effective at some distance from the eye, although it is wanting in those black shadows which are of great value in all carving. It is pointed out by Owen Jones in his Grammar of Ornament that there is a characteristic feature of Greek ornament continued by the Romans, but abandoned during the Byzantine period, which is that the various parts of a scroll grow out of each other in a continuous line. "What is evident," remarks this author, "is that the Greeks in their ornament were close observers of Nature; and although they did not copy, or attempt to imitate, they worked on the same principles. The three great laws which we find everywhere in Nature — radiation from the parent stem, proportionate distribution of the areas, and tangential curvature of the lines—are always obeyed, and it is the unerring perfection with which they are, in the most humble works as in the highest, which excites our astonishment, and which is only fully realised on attempting to reproduce Greek ornament, so rarely done with success."

The brothers Adam in the last century infused all the refinement of Greek feeling into carving applied to similar purposes; whereas modern French architects have rather traveled in the opposite direction, making nearer approaches to imitations of natural foliage, and often allowing their carved ornament to spread out over the mouldings of the panel containing it, as if it had outgrown its proper boundary. This shows an amount of license which the severity of classic taste would strongly condemn; and it is difficult to see where such arbitrary transgressions of architectural principles are to cease when they once begin. The skill of the artist should find ample scope in designing ornament which will adequately fill any panel or other defined surface. —The Stonemason.

Shading Marble.

A newly discovered process for treating marble or other similar stones in order to give them any colored shade, veins or spots, consists in leaving these stones in one or more baths composed of a solution of alcohol and one or more colors of aniline or other coloring materials. The coloring materials are fixed by leaving the colored stones in a bath of oil or any other fat substance, or by applying upon the stones layers of the same stuff. The absorption of the organic coloring materials and of the fat substances by the stone may be accelerated by heating or boiling the bath which contains the stuff to be treated.—New Haven Morning News.

Italian Marble Statistics.

It appears from a report recently issued by the Italian Government that in 1897, for the first time for many years, imports of Italian marble into Great Britain exceeded those into the United States. In 1896 the exports to the United States totalled 36,497 tons. In 1897 there was an increase of the shipments to Great Britain of 12,088 tons, and a decrease to the United States of 8,988 tons.

The difference in the set of trade can be more readily seen from the following statement:

	GREAT BRITAIN	UNITED STATES.
1896	35,139 tons.	36,479 tons.
1897	47,227 "	36,479 "

The following are the number of quarries and production in 1897:—

	No. of Quarries. In work.	Out of work.	Tons of marble Produced.
Carrara	311	487	179,117
Massa	54	185	29,701
Versilia	106	121	28,140
	471	793	236,958

Fort Dodge, Ia.—Louis Krueger, a farmer living south of the city, has unearthed a valuable deposit of gypsum. The vein is twenty-four feet thick and lies only seven feet beneath the surface.

SLATE TRADE.

The Slate Industry in 1898.

General Business Conditions.—The demand for roofing slate for home consumption during the year 1898 was somewhat more than for 1897, and the export trade has been very gratifying to quarrymen. The uncertainty preceding the war with Spain was responsible to some degree for retrenchment in building operations, which lessened the call for structural slate. Following the depression in business, stocks of roofing slate began to accumulate, resulting in shading of prices and keener competion among quarrymen for what business was offered. As the year advanced prices became more demoralized, and in August the Vermont Slate Company, better known as the "Sea-green Trust" in Vermont, had to go out of business, owing to dissension among its members. Fully one-third of the slate held by the trust was owned by Norton Brothers. When a disagreement arose between the members prices became unsettled, and cuts of 60c. and over were made on sea-green and intermediate green slate. Efforts were made to start a new association among the smaller quarries, without success; instead, operators reduced wages, and some closed down altogether. Such a break in prices caused the Pennsylvania quarrymen to follow suit, some closing their quarries, and in the last quarter of the year dealers in the East were able to purchase quantities of various sizes and kinds of roofing slate at very low prices; so much so, that we are unable to give the actual selling quotations. We give below what are known as list prices. Probably the only slates that held any way firm in price are "Red" and "Unfading Green," but these are modified by discounts of all kinds For the former a fairly good demand existed all through the year. The stock of unfading green slate now on hand is considered quite large, though the export market is taking much of it.

The Bangor Roofing Slate Manufacturers' Association, which was formed about four years ago, has a membership of 12 of the leading producers of roofing slate in the Bangor region. It is not a pool, nor does it endeavor to control the business of its members; it only guarantees the genuine Bangor roofing slates, and on each lot sold the members append its certificate. The business of the association within the past four years is best shown by the following number of squares of roofing slate which is marketed: Domestic, 150,000 squares, against 139,600 squares in 1897, 136,700 squares in 1896, and 102,700 squares in 1895. Exports, 75,000 squares in 1898, 50,820 squares in 1897, 8,330 squares in 1896, and 2,870 squares in 1895. The totals were 225,000 squares in 1898, 190,-420 square in 1897, 145,030 squares in 1896, and 105,570 squares in 1895.

As the year closes a revival in building operations and a good export demand exists, and prospects for the quarrymen are encouraging.

Mill stock with few exceptions ruled quiet throughout 1898, and prices were not very satisfactory. In slate for electrical purposes the demand has improved, owing to its excellent non-conducting qualities, and some good sized orders have been booked. Blackboards yielded a comparatively small profit to the manufacturer. Early in the year blackboards were quoted at 10c. per square foot for 3 ft. wide, 11c. for 3½ ft. wide, and 12c. for 4 ft. wide, while in September they were 1c. higher for all sizes. School slates were in demand for export, while at home

a curtailment in sales was manifest. Marbleized slate has rather gone out of fashion, but an increased export trade has been done during the year. It is difficult to quote on mill stock, as much of it is sold according to specification. For plain work, such as 12-in. tile and treads made from red slate, makers quote for 1 in. stock 40c. per square foot, and for 1½ in. stock, 60c. Manufactures of any other colored slate are quoted comparatively cheaper. Marbleized slate valuations depend upon workmanship, size and shape.

Ground slate is used in making up certain roofing paints, as a backing for oil cloth, as a filler or first coat in some outside painting, and to a small extent for the same purpose in coach painting. This article comes in five colors, green, red, olive, slate and dark brown or drab. The ground pigment is mixed in oil by the buyer. It is said that this makes a durable paint, but it consumes much oil in grinding. For the red and olive ground flour $7.50 per ton is asked in carload lots.

It is suggested that waste and broken slate could be utilized by grinding and making into bricks. A mill for making bricks of this character was in successful operation some years ago at Phillipsburg, N. J., and readily disposed of its entire product, but it was burned down, and for some reason has never been rebuilt.

The manufacture of slate pencils has been neglected in this country, owing to the low cost of the German soapstone pencils. Some years ago a slate pencil factory existed in Vermont, and there were a few quarries in Pennsylvania that produced a suitable slate for this purpose, but the venture has been found unprofitable.

Export Trade.—This branch of the American slate industry has made excellent progress within the last few years, and so rapidly has it grown that our exports in 1898 shows a very large increase over any twelve-months' on record. It is estimated that fully 290,000 squares of roofing slate were exported in 1898. At first 90 per cent. of the slate exported went from New York, but now shipments are made also from Philadelphia, Baltimore, Newport News and Boston. New York, however, still sends forward nearly 70 per cent of the slate exported.

U. S. SLATE EXPORTS.

Month.	New York.		Other Ports.		Total U. S.	
	1897.	1898.	1897.	1898.	1897.	1898.
January	$39,366	$86,480	$10,344	$20,358	$49,710	$106,838
February	36,316	50,482	29,824	30,394	66,140	80,876
March	37,622	91,889	16,174	31,666	53,796	123,555
April	58,125	73,698	33,861	24,165	91,986	97,863
May	87,821	112,285	36,628	24,910	124,449	137,195
June	56,340	97,050	22,139	34,956	78,479	132,006
July	72,075	93,533	39,098	30,599	111,173	124,132
August	109,698	80,305	24,119	45,743	133,817	126,048
September	90,059	93,751	49,417	32,931	139,476	126,682
October	71,354	79,928	46,873	26,415	118,227	106,343
November	55,239	75,220	24,488	20,000	79,727	95,220
December	76,329	62,302	22,353	30,000	98,682	92,302
Totals	$790,344	$996,923	$355,318	$352,237	$1,145,662	$1,349,160

The exports from United States in 1896 amounted to $515,058, and in 1895 to $84,599.

This export business had its opportunity in the labor troubles in Wales. Although the Welsh quarries have resumed operations, and are making strong efforts to shut out foreign slates, American exporters are pushing their trade, even establishing a stock yard in London where their slates may be displayed. They are also selling on the Continent and in the East, and only a short time ago a New York merchant went to South Africa to build up a market for roofing slate there.

Our exports consist mainly of the larger sizes of roofing slate, and in many cases of the heaviest. We also sent abroad

much rubbish slate which is used for building foundations and wall partitions, acting as a damper. Mill stock has also been shipped, but manufacturers are reticent about their foreign orders. School slates find a small market in the East.

Of late methods of transporting slate have been improved, and more care is exercised in handling it, resulting in a smaller percentage of breakage, and a material saving to the exporter. The leading shippers have their own stevedores at the port of shipment, who superintend the loading of the slate on the vessel.

Prices on export slate have been somewhat less during 1898 than in 1897, owing to the competition among quarrymen. Efforts have been made to remedy this situation by forming an association of the exporters but nothing has yet come of the matter.

The largest exports were made to the United Kingdom, where increased building operations demand a supply of slate. London received most of our roofing slate. There have also been several shipments of mill stock to Great Britain in the form of slabs, but the larger part of the exports were in roofing slate.

Australasia is the second largest consumer of American slates, and of the five colonies to which we have sent roofing slate Western Australia stands foremost. The next in importance is New South Wales wherein Sydney imported all the slate.

In Germany the demand is principally for small sized slate, and the largest quantity is imported by the city of Hamburg, with Bremen second, and Stettin third. In Denmark they desire large slates, and so far we are shipping to only one port there—Copenhagen—which is buying a fair amount of roofing slate and some mill stock. In Norway the city of Christiana received some slate from the United States, and in Sweden, Gothenburg. In Holland, Amsterdam received a few lots of roofing slate. Antwerp, in Belgium, is a fair market for our slates, and some slabs have gone there.

South Africa is a buyer of school slates, and occasionally a small lot of roofing slate is sent to Natal or Cape Town. Efforts are being made to introduce roofing slate there. India for several years has been receiving some school slates. China has been a purchaser within the past year, the city of Hong Kong taking a lot of school slates.

South America, though it has taken slate only in small quantities, but a market for our product can be cultivated there. Central America and the West Indies have shown demand, the principal importer being Kingston, in Jamaica.

Canadian territory has not been worked as actively as might be expected, but slate manufacturers have sent their goods to St. John's, in Newfoundland, and to Halifax, in Nova Scotia.

The exports of roofing and manufactured slate from New York during 1898 were the largest on record, amounting to fully $200,000 more than in 1877, when they were $714,709. During the past twenty-two years this trade has shown many changes, dropping to $94,737 in the year ending December 31st, 1883, and to $19,684 in the fiscal year ending June 30th, 1894. In the calendar year 1897, however, these exports reached the large sum of $790,344, and in the present year they amount to considerably more. The majority of the slate sent abroad since 1876 was for roofing purposes, although mill stock played a part also in our export trade. This mill stock consisted largely of slabs, although there were fair sized lots of mantels and similar manufactures. Among the first American quarrymen to form connections abroad was the firm of John Galt & Son, and to-day there are many others who are exporting large quantities of slate. Mr. Charles A. Morrison within recent years is representing a German export house, besides having connections with Englishmen who have become interested in the American slate industry.

Competition among exporters of roofing slate particularly has become very keen. The average price of the quality of roofing slate exported is about $2.50 per square at quarry in Pennsylvania, and allowing 12s. 6d. for ocean freight, the cost in London has been as follows,

allowing 3½ squares to the long ton:

	U. S.	Sterling
Slate at quarry, per long ton (2,240 lbs.)	$8.75	36s. 6d.
Freight to New York	2.75	11s. 5d.
Ocean freight	3.00	12s. 6d.
Unloading, storing, etc.	1.44	6s. 0d.
Total	$15.94	66s. 5d.

The present price of Penrhyn second quality, 20 by 10 in., roofing slate at the shipping point in Wales is 142s. a thousand (about seven squares of American slate.) This would make the cost of Welsh at the quarry 9s. more per thousand than an equivalent quantity of American in London. Nothing has been said of the freight on the English railroads for the Welsh slate, as to all points except in a small district the rates from London would be nearly the same as from the quarry. Our export business, therefore, depends greatly upon the ocean freights, which are variable and may cancel the present advantage at any time, or may increase it.

Freight market.—It is the custom of exporters of slate to make contracts with transportation companies direct or through freight brokers for vessel room for periods of six or twelve months at a stipulated figure and for a certain amount of space each month. For many years steamship companies would not permit exporters to ship roofing slate in bulk, requiring it to be put in crates, an extra expense to the shipper. Only after long discussion would the steamship companies allow roofing slate to be sent forward in bulk. To-day a large proportion of the state exported is used as ballast in cotton vessels and others carrying light freight. Freight rates at the opening of the year were rather strong. Contracts were made in the first quarter of the present year to London at 12s. 6d. At the opening of the second quarter the movement of slate began to increase, and in June steamship companies were asking 15s. 6d freight to London on spot business. There was some difficulty from the war for the Atlantic Transport Company, which handles much of the slate shipped abroad, sold seven of its vessels to the Government. Early in July a freight rate to London on contract could have been secured at 10s. 6d., and at 12s. 6d. to Newcastle and Manchester. In August trade at New York fell off somewhat, gaining at other ports, while spot Newcastle freight was given at 17s. 0d., and 15s. to London. For Stettin, Germany, the freight rate was 17s. 6d., from New York. September opened with a little better feeling in shipping circles, but freight rates were about the same, only that a shipment from New York to Cork, Ireland, was made at 18s. The shipments from New York in October were being curtailed owing to the increasing movement of merchandise and the rising ocean freight rates. Steamship companies were firm in asking 15s. for prompt shipments to London, although a few contracts were bid on at 12s. 6d. to 13s. 9d., the latter figure being beyond the expectations of the exporters. Newcastle spot business ranged from 15s. to20s., according to the time of shipment and amount of space available on the outgoing steamer. A few orders were booked for Newcastle for six month's time at something less than quoted above. Liverpool room was offered in October at 17s. 6d., and the same rate was asked to Bremen, Germany; while to Copenhagen, Denmark, 20s. ruled. Competition between the steamship and sailing vessel concerns was instrumental in reducing the freight rate to Melbourne and Sydney to 10s., which is much less than has been asked to London, notwithstanding the greater distance. From this 10s. freight a 10 per cent. rebate is allowed, while to the United Kingdom and Europe the rebate is only 5 per cent. November is always an irregular month for shippers, and usually considerably less is done in exports. During that month nearly all the freight room was taken by grain, cotton and similar merchandise. Spot business to London was quoted from 15s. up to 20s., and contracts were offered at 13s. 9d., while exporters were reluctant to accept. Newcastle freight ranged from 16s. up, and to Liverpool 15s. was asked for prompt shipment. South African business was quoted at 22s. 6d. to 23s. to Natal and Cape Town, principally. As the month closed there was an easier feeling in freights, and suitable room is obtainable to many of the foreign ports.—Engineering and Mining Journal.

THE LIST PRICES PER SQUARE FOR NO. 1 ROOFING SLATE OF STANDARD BRANDS,

F. O. B. quarries. For exporter's use we have added the number of squares and weight per mille.

Size in Inches.	No. Pieces in Square with 3-inch Lap.	No. Squares per Mille. 1,260 Pieces	Estimated Weight per M. 1,260 Pieces	Monson or Brownville	Bangor.		Bangor Ribbon.		Albion or Jackson—Bangor.		Lehigh.	Peach Bottom.	Sea Green.		Unfading Green.		Red.	
		Sqs., Ft.	Cwt.	1898.	1898.	1897.	1898.	1897.	1898.	1897.	1898.	1898.	1898.	1897.	1898.	1897.	1898.	1897.
24x14 ..	98	12.86	74	$6.10	$3.50	$3.50@$3.85	$3.00	.....	$3.25	$3.40	$3.50	$4.85	$2 50@$2.90	$3.25	$4.50	$3.50	.....	.....
24x12 ..	115	11.03	63	6.60	3.50	3.50@ 3.85	3.00	$3.00@ $3.25	3.25	3.40	3.50	5.00	2.60@ 2.90	3.35	4.50	3.50	.....	.....
22x12 ..	126	9.97	57	6.60	3.60	3.60@ 4.10	3.00	3.00@ 3.50	3.25	3.70	3.50	5.00	2.60@ 2.95	3.35	4.50	3.50	.....	.....
22x11 ..	157	9.15	52	6.50	3.60	3.60@ 4.10	3.10	3.00@ 3.50	3.25	3.70	3.75	5.00	2.75@ 2.95	3.45	4.50	3.75	.....	.....
20x12 ..	141	8.92	51	6.90	3.60	3.60@ 4.10	3.10	3.00@ 3.50	3.25	3.70	3.75	5.00	2.60@ 2.95	3.35	.....	3.75	.....	.....
20x10 ..	170	7.43	43	6.80	4.25	4.25@ 4.60	3.35	3.25@ 3.50	3.50	4.00	3.80	5.10	2.75@ 2.05	3.45	4.80	4.00	$10.50	$11.00
18x12 ..	160	7.88	45	6.80	3.60	3.60@ 4.15	.....	.....	3.25	3.70	.....	5 00	2.60@ 3.95	3.35	.....	3.50	.....	.....
18x10 ..	192	6.56	38	7.20	4.25	4.25@ 4.60	3.35	3.25@ 3.60	3.50	4.00	3.80	5.10	2.60@ 2.95	3.45	4.80	4.00	10.50	11.00
18x9 ...	213	5.91	34	7.10	4.40	4.40@ 4.90	3.35	3.25@ 3.75	3.50	4.00	3.80	5.10	2.60@ 2.95	3.35	5.00	4.00	10.50	11.00
16x12 ..	185	6.83	39	6.80	3.60	3.60@ 4.15	.....	.....	3.25	3.70	.....	.....	2.50@ 2.90	3.15	.....	3.50	.....	.....
16x10 ..	222	5.69	33	7.10	4.00	4.00@ 4.50	3.25	3.25@ 3.75	3.50	4.00	3.80	5.00	2.50@ 2.90	3.15	.....	4.00	10.50	11.00
16x9 ...	246	5.12	29	7.00	4.25	4.25@ 4.75	.....	.....	3.50	4.00	3.80	5.10	2.25@ 2.85	3.00	5.00	4.00	10.50	11.00
16x8 ...	276	4.55	26	7.20	4.25	4.25@ 4.75	3.25	3.25@ 3.75	3.50	4.00	3.80	5.10	2.25@ 2.85	3.00	5.00	4.00	10.50	12.00
14x10 ..	262	4.81	28	6.60	3.60	3.60@ 4.15	3.25	3.25@ 3.60	3.25	3.70	3.75	.....	2.25@ 2.85	3.00	4.80	3.75	10.50	11.00
14x8 ...	327	3.86	22	6.50	3.75	3.75@ 4.25	3.25	3.25@ 3.60	3.25	3.85	3.40	4.85	2.20@ 2.45	.....	5.00	4.00	10.50	11.00
14x7 ...	374	3.37	19	6.40	3.90	3.90@ 4.25	3.25	3.25@ 3.60	3.25	3.85	3.40	4.85	2.15@ 2.20	.....	5.00	4.00	10.50	11.00
12x8 ...	400	3.15	18	5.50	3.25	3.25@ 4.00	.....	.....	3.25	3.40	3.25	4.60	2.15	.....	4.00	3.25	9.00	9.75
12x7 ...	457	2.76	16	5.00	3.25	3.25@ 3.75	.....	.....	3.25	3.40	3.25	4.60	.....	.....	4.00	3.25	9.00	9.75
12x6 ...	533	2.37	14	4.80	3.25	3.25@ 3.75	.....	.....	3.25	3.40	3.25	4.60	1.95	.....	4.00	3.25	8.50	9.75
Av. Pr.	.....	.....	.....	6 50	3.76	4.00	3.19	3.24	3.33	3.73	3.42	4.93	2.34	3.26	4.63	3.71	10.08	10.77

In Brownville and Monson delivery quotations can be had somewhat lower than above, which is also true of other brands. No. 1 Bangor are 50c. extra when full 3-16 in. thick. Purple sizes run 24x16 to 10x9 in., and vary from $3.75 to $4.00 per square, against $3.25 to $4.50 last year. Variegated and mottled are the cheapest roofing slates at $1.75 to $2.90 per square, according to size. Intermediate sea green, sizes 24x14 to 18x10 in., $2.25; 16x12 to 16x10 in., $2.10; 16x9 to 14x8 in., $2.00 per square.

In the table above where 1897 prices have been omitted it means that they varied little from 1898. The good export demand for unfading green roofing slate has raised prices in 1898. Within the past twenty years prices have diminished greatly, and sales in 1898 have been made at considerably less than the list prices.

Peach Bottom Prospects.

A new era seems about to dawn in the history of the Peach Bottom roofing slate. Our slate operators, almost without exception, were trained in the mining and manufacturing of slate. As such they are experts and a success. It is in handling the other end of the business—the marketing where their weakness has been manifest.

The time was when Peach Bottom slate sold themselves on their merits alone. But in the last generation new business methods have been applied throughout the country. New conditions have to be met, and the man of the olden time finds himself distanced in the race. Manufactures of roofing slate in the other regions years ago caught on to the order of things, and by persistent advertising and drumming of trade they have pushed their slate on the market; while the Peach Bottom slate operators, with an article acknowledged the best in the world, have found their product accumulating on their hands. They have depended on the merits of the slate to continue their sale, believing that "every one knows the quality of the Peach Bottom slate." But such is not the case. At the present day not one person in ten, even among architects and builders, fully realizes the superior quality of these slate for roofing purposes.

Recently, however, a new company of business men has been formed with command of abundant capital, to handle the Peach Bottom slate and place them on the market. It has been said, with the proper amount of judicious push, and the application of modern methods in the business, a profitable market can be found for five times the average annual product of the Peach Bottom slate region. We believe the statement can be verified. And should this new company go forward in the course they have mapped out, with the co-operation of the slate operators, we feel justified in saying that the Peach Bottom slate region is on the verge of one of the most prosperous eras known in its history.—Delta Herald and Times.

Slate Trade Prospects.

The handwriting on the wall is clear to the effect that an era of prosperity for the slate interests will be ushered in during 1899. The crest of the wave of general prosperity is high and plainly in sight already. The more sanguine say it is upon us and that the whole country has felt the swell for months past. The slate business had not really had a very serious time of it when compared with most other lines of business, and it is likely to be the last to feel the revival, just as the roof is the last the builder provides for and puts on. Still the building cannot be complete without the roof—no more can general prosperity set in and bless this land without lifting up and improving the slate business. Are the manufacturers preparing to meet the change with a fair, uniform price for their goods, or will they meet it with the reckless indifference and unbusinesslike methods of the past two years and ruin their prospects from the start? We would suggest that this question be taken into serious consideration early, so that the slate trade may reap its share of the general prosperity from the very beginning.—Slate.

TIMELY TOPICS

Announcement. This number of STONE is the last one that will be sent out from Chicago, and the last one that will be issued by its founders, who have been its publishers for nearly eleven years. The magazine and its business will be transferred to New York City, and the March number will go forth from the new offices of the publication, No. 45 Broadway, (Aldrich Court), that city. It is not necessary to state why the change is made. The new ownership concurs in what we have for many years recognized—that the advantageous location for STONE is the point where it will now go. In the East are located the greatest centers of production, and the greatest markets for stone, marble, granite, slate, cement and lime, the industries which this publication has so well, (we think) represented almost solely for so many years. While STONE has, in no sense, been a sectional organ, nevertheless this point must be approved, that there is advantage in having headquarters near to the greatest number of people with whom one has, or expects to have, intimate business relations. A branch office will be maintained in Chicago, probably in our charge. Subscribers and patrons will not be affected by the change in any manner except to better their relations with the magazine. It is to be enlarged in size, be made more elegant in appearance, and its field exploited to greater extent than heretofore.

We commend to the gracious consideration of the thousands of steadfast friends, who have stood by us and approved our work through these many years, the able, experienced and progressive publisher who succeeds us. He will make up for our shortcomings. He will glorify all the good work we have done.

There has never been a more sorrowful moment to us, than the one when we affixed our signature to the articles that took away from our keeping this child of our creation; which we have guided so affectionately through the varying changes of the many long years that we have watched and worked and, alas, worried over it. It passes into the guardianship of a more vigorous master of the profession—which is some compensation for the sorrow its passing leaves to us.

The future publisher of STONE is Mr. Frank W. Hoyt, who for twelve years was business manager of the Albany *Argus*, and for the past six years has been connected with the Century Co., in the responsible position of director of the constructive features of the *Century Magazine* and of the great books published by that company.

We bespeak for him the cordial support of every one interested in the industries represented by STONE.

THE D. H. RANCK PUB. CO.

The Labor Situation in New England. The granite manufacturers of the New England centers of granite production have considered the matter of conceding to the cutters the advance in price for work from 29½ cents an hour to 32 cents an hour, which the Granite Cutters' Union gave notice December 1 they should demand. They have practically decided that the concession cannot be granted. Although the union men are non-communicative on the subject it is believed that they are resolute and that they will abide by their decision in the matter. The manufacturers are inserting in all of their contracts the strike clause or one pertaining to labor troubles. This would seem to indicate that they fear a strike and are fortifying themselves. The list of prices under which the men are working at present was made March 1 last and is operative for one year. According to the agreement existing between the manufacturers and the cutters this schedule cannot be changed without giving a three months' notice. Should the strike go into effect, which there is more reason to think it will not, than it will, it would involve 8,000 or more men. There is an evident disposition on the part of some of the cutters to stay the strike proceedings. The manufacturers are reticent about the matter and just what turn affairs will take in the matter is hard to predict. It is safe to say, however, that every effort will be exercised to obviate the impending trouble.

Stone Dry Docks. Several of the bids for construction of a dry dock at Boston of stone and concrete are little in excess of the sum appropriated by congress for each of the three new wooden docks it has ordered, and the dimensions of all four docks are the same. This disposes effectually of the contention that the cost of substantial docks is so great as to make it wise to build wooden docks. The latter decay quickly and warships are in constant peril while they are docked in them for repairs. The small difference in the cost of stone and concrete and of wooden docks gives congress no further pretext for insisting on wooden docks. Indeed, it has always been mysterious why congress, with the costly experience of the country with wooden docks, should have preferred the latter. Desire for economy cannot be the explanation, for these docks have been anything but economical. Now that it has been demonstrated that docks of stone and concrete can be built almost as cheaply as wooden docks, congress ought to instruct the secretary of the navy to call for bids for construction of all new docks of these materials.

A Monumental Problem. There is no business in the world in which people are gulled any more than they are in the buying of monuments, says the editor of a country paper. "It is a line in which few people, aside from dealers, are posted and, knowing this, unscrupulous venders the country over, are actually robbing the people right and left by charging tremendous prices for inferior work. Bereaved ones desiring to erect a monument to the memory of their dead are always anxious to go as far as their means will allow in making this memorial one which will show the appreciation in which the departed are held. In making the purchase of a monument, however, the buyer must depend absolutely upon the judgment and honesty of the seller. The buyer knows little or nothing of the relative

lasting qualities of the different pieces of marble or granite shown. He knows nothing of the actual value of the article. He knows nothing of the proper method of setting the stone so that it may remain in position for a long term of years. In all these important matters he must take the word of the seller. How foolish it is then for people to purchase monuments from dealers living a long distance from them, or from dealers whom they know neither personally nor by reputation, or from traveling agents whom they will probably never see again, once the monument is set up and paid for. The place to buy such work is from a dealer whose reputation for honesty is unassailed, from the local retail dealer whose work has stood the test of years and has been found to be all that was represented. Such a dealer is John Smith."

The country editor who has thought out these "thunks" is more pointed in his remarks than the editor of the monumental journal dares wisely be. For, in truth, the latter knows "it 'ees 'ard" to lie on a life line and a dead line at the same instant. His journal is made for the local dealers—his means to make it is provided by "dealers living a long distance from them," and the twain of dealers mentioned don't get along very happily together, as you may infer from the country editor's remarks. The honest editor of a monumental journal is not as unselfish as he would like to be. Hence, let it be understood how grievous a task is his, while he roasts on one side and freezes on the other side of this monumental problem.

Government Ads.

On the plea of economy, the rule has been established in the cabinet department of the National Government, to advertise its contract lettings in a few papers only—one in the city where the public work is contemplated, or where it maintains a warehouse if the letting is for supplies, and in one or two publications which have had a "pull" strong enough to warrant making the insertion of such advertisements a specialty by the use of the Government's name in their private business. This is all wrong, and the worst sort of economy. If the Government issued directly to the people a publication containing its proposals, no objection could lodge against it, except on the score that it would cost more and be less effective, than to have the advertising placed in established journals that are recognized as the leading exponents of the industries from individual firms in which the Government seeks to do its business by contract. We might illustrate this better by referring to an instance in our own experience. Several years ago over a hundred of the prominent quarrying and stone contracting firms of the country—interested in government work—petitioned the Treasury and War departments of the Government to place their proposals for stone for public buildings and works in STONE, the recognized journal of the stone industries. Their argument was to the effect that their self-interests were involved in the success of the journal; that they consulted it preferably for information of a trade character, kept it on file, and could depend on it in every way. The publishers issued for their especial benefit a weekly news bulletin, containing current information of contract work, which they received, by sealed mail, in advance of any other publication. They respectfully requested that the departments would insert proposals for stone in their trade advocate, so they would be sure to see them, know they were absolutely correct in text, and have them at the earliest possible date; that it was un-

just to require them to subscribe to a number of high-priced publications to secure the information they were directly interested in, when their subscription to STONE alone was all that was necessary. The secretaries of the departments mentioned answered by requesting our rates, dates of publication, etc., and announced that the journal had been listed for the insertion of such advertisements of the Government which in the judgment of the department was considered expedient to insert therein. It is needless to say that was the last heard of it. STONE has not exerted any influence on the bureau chiefs (in the respective departments) who have the responsibility of this matter, and the advertisements of proposals have continued to be made in so-called building and general contracting journals and the local dailies. So far as the special feature of proposals for stone is concerned they could be inserted in STONE for one-tenth the cost to the Government, and be ten times over more satisfactory to those interested in them. A later incident is shown by the Navy Department's bids for the construction of a stone dry dock at the Boston navy yard. for which congress has appropriated $1,025,000. The ads appeared in only two newspapers one in Boston and one in New York, for reasons of economy, and on which the Philadelphia Record comments as follows: "It will be difficult, however, for persons unversed in administrative affairs to understand the economy which has virtually cut down opportunity for competition for the erection of a public work which is to be one of the finest of its kind in the United States. The Navy Department ought to issue an explanatory desertation on economy."

SELECTED MISCELLANY

Thawing Dynamite.

All nitro-glycerine compounds freeze and become hard at about 42 degrees Farenheit. In this condition they will not readily explode. When large quantities of powder are to be used a separate building for that purpose should be fitted with a small steam radiator. Use only exhaust steam for heating the same if possible, keeping the temperature of the room at about 80 deg. Fahr. In the part of the room at the greatest distance from the radiator, place the powder on racks to thaw. When but small quantities are required to be thawed, a thawing kettle may be used, being two water tight kettles (one smaller than the other), the cartridges to be placed in the smaller kettle, and the space between the two kettles filled with hot water at from 120 to 130 deg. Fahr., the kettle being fitted with a cover to retain the heat. Under no circumstances, however, should the kettle be placed over the fire to heat. When more hot water is required, empty out the cold water and fill again with hot water.

Labor-saving Devices in China.

In reply to an export association in New York, Consul-General Goodnow, of Shanghai, writes as follows under date of November 3, 1898:

I cannot give you any encouragement in regard to the shipment of wheelbarrows, scrapers, dump carts, and the like to China. The wheelbarrow used here has one large wheel in the middle and a seat on either side, where passengers or loads are carried. Once in a great while, dirt is carried in baskets on such a barrow, but ordinarily it is carried by a coolie in two baskets hung on the end of a bamboo rod balanced on his shoulders. These baskets are about the size and shape of a grain scoop. Labor-saving devices are not in demand in China. The cheapest thing here is a man. There is more labor than can find employment. A coolie carrying dirt will receive from 7 to 10 cents gold per day. He must work from sunrise to sunset—not very steadily or very intensely, but putting in a great many hours and accomplishing a large amount of work for the amount of wages paid. There are more coolies willing to work for this pittance than there is work for them to do.

The Houses of the Picts.

There are stone remains in Scotland of a dreary and mysterious darkness — the Picts' houses, or Eird houses of the north, belonging to an age who shall say how many centuries older than that of the old square keeps? You enter crawling along a cavernous drain-like passage, which descends and widens into a chamber. This chamber may be from 3ft. to 6ft. high and 20ft. or 30ft. long. Its sides are made of rough huge stones, laid on each other so that the walls converge upwards, where great blocks of granite are laid across them. You pass through a lateral narrow opening and enter another chamber of a like character. Some of these houses have three or more chambers. They are met with in fields, where the husbandman has for centuries passed the plough over them, unconscious of their existence or of any further peculiarity than a slight ascent, with a projecting stone or two dangerous to the plough. Nor are these cavernous edifices mere rare anomalies. In some places, and chiefly in the upper basin of the Don, there are complete villages of them. Professor Stuart, in a paper read to the Antiquarian Society of Scotland, mentioned between forty and fifty as the number opened in one parish. It is in the Orkney Isles, however, that they are found on the largest scale, and most elaborately built. The traditions of the country, not unnaturally, associates these and other mysterious antiquities with a race which, according to the popular but now superseded history of Scotland, was extinguished in conflict with the nation now occupying the soil. Hence they are deemed the dwelling-places of the Picts or Pechts, being endowed with elvish faculties and malign propensities. They are supposed to have been of superhuman strength, but diminutive and dark, and no wonder when such were their habitations. With the Orcadians, the possible existence of a lingering remnant of the of the Pechts, dwelling in the recesses of the earth, is still a matter of substantial apprehension. Mr. Stevenson the engineer, the father of the author of "Treasure Island," when passing through Orkney on lighthouse business, was called upon by the people of a small tavern to decide for them a very important point. A being was then asleep in one of their beds whom they verily believed to be a remnant of the accursed and not quite extin-

guished race—so diminutive was he and so black withal. Now, if their suspicions were well founded, they would be under the disagreeable necessity of putting him to death, and this was just the question which Mr. Stevenson, being a lighthouse engineer, should decide for them. On entering the chamber, Mr. Stevenson, with curious sensations beheld, in unconscious and peaceful repose, the familiar face of an old schoolfellow. He was a being of slender proportions and not very comely visage, but of a restless, enterprising enthusiastic character, being no other than the Rev. John Campbell, subsequently renowned in African missionary history. Did, then, human beings live here in chambers not much wider than graves, in contact with the slimy walls and with the company of a few snails and toads? —no rats, for the rat would not inhabit such a place. That houses of this laborious structure should have been built for the people at large is out the question, so that we must suppose them to have been in a manner the mansions of the aristocracy.

Martello Towers in England.

Whatever may have been the defensive value of martello towers a century ago, it has entirely evaporated now, and it is not surprising to find that one or two of them at Bawdsey Haven, on the Suffolk coast are being demolished. There are a good many of them on the coasts of Essex, Suffolk, Kent and Sussex. These massive round towers, some forty feet high, were regarded as, and very likely were, splendid defenses at the time they were erected, but they have long been used only for coastguard purposes. Their name is derived from the Italian coast towers which were erected as a protection against pirates. Warning that a suspicious craft was in sight was given by striking a bell with a martello, or hammer. It was the powerful defence made in 1794 by Le Tellier at the tower of Martella, with only thirty-eight men, against a simultaneous sea and land attack, led by Lord Hood and Major General Dundas, which brought them into favor in this country. It was thought that they would be a splendid defence against "Boney."—The London Chronicle.

BUSINESS TOPICS

Contributed by the National Association of Credit Men.

Prompt Payment of Bills.

In these days of small profits and close competition it is surprising to note the apparent lack of regard shown by the average retailer for the payment of his obligations as they mature.

It is not unreasonable to presume that the majority of retail merchants have a thorough understanding as to the terms upon which they make their purchases, and yet, with that knowledge, they fail to adopt some simple and systematic method by which they would know each day what payments they would have to make. They seem to prefer to depend upon their general knowledge of what they owe and what is or will be due. A small yearly diary or tickler could be obtained at a trifing expense and when bills are checked in as ready for payment they could be entered upon proper date for discounting or for payment at maturity.

Notes or other items such as taxes, interest, rents, etc., could also be entered therein. By this method a merchant would always have before him his maturing obligations and could make his calculations accordingly. Many jobbers and manufacturers would do well, also, to inaugurate and keep up such a system. The disregard of maturing bills and notes payable is not confined altogether to the retailers. There is perhaps some excuse, in this respect, for the retailer, on acocunt of his lack of help and personal devotion to the other details of his business, and because in many instances he is bookkeeper, collector, manager and everything else; but for such neglect on the part of a jobber and manufacturer with the necessary help at their command there is no excuse whatever.

Merchants have their own ideas as to how they wish to pay their bills, but they have no right to say when they shall pay them. The terms of sale govern that feature of business.

Very few houses take an arbitrary stand and refuse extensions to a worthy customer, when asked for in a proper manner, but the idea is rapidly growing in the business world that the customer who persistently steals extra time and ignores the creditor's rights is entitled to no very great consideration. The retailer who permits his bills to go unpaid and who fails to arrange in a business-like manner for the extra time wanted is "standing in his own light" and is helping to compile a record of experience against himself that will work him more injury from a credit standpoint than by any other course of action short of downright dishonesty.

Be just and punctual, be considerate and frank, and be systematic regarding details. Always remember that your creditors are your friends and will more than reciprocate honest, frank and business-like treatment from you in all matters of daily business life.—G. B. Pulfer.

Business Procrastination.

The distinctive difference to be noted between the active, pushing and successful man of business and the unsuccessful and discouraged man is frequently found in the simple matter of the improvement of time. The one seizes upon every oportunity as it is presented, and, acting promptly, profits by it. He is alert and his movements are rapid. The other, with perhaps as clear perception of the situation, at the first fails to reach the goal in time simply from constitutional inertia or the bad habit of procrastination. The saw has it that "Procrastination is the thief of time." Another truism is that "Time is money." It follows, then, that procrastination steals money. Certainly procrastination loses the opportunity to make money, and in many cases completely destroys the retailer's profit.

There is no man in business in whose management of affairs promptitude counts more than with the retailer. The consumer's wants are imperative. The retailer, to profit by supplying those wants, must act instantly. Is a new article asked for? It must be found and supplied quickly, or else a competitor gets the advantage. Does some event occur that can be turned to advantage in an advertising way? The oportunity must be seized upon instantly or the effect will be lost. Are discounts offered for prompt payment? The remittance must be dispatched by the specified date, or else the coveted percentage is not secured. Are there accounts to collect? The bills must be presented at the time they are due and every reasonable effort put forth to secure their payment, or else loss from bad debts will be the ultimate penalty. Procrastination in collections costs large sums of money every year to retailers and to other merchants as well. First, it deprives them of the use of the money which would secure discounts on purchases, and, second, it helps the debtor to get into a position where he cannot be made to pay even by legal process.—Warren Jeffries.

SITUATIONS WANTED.

Advertisements under this heading inserted for subscribers to STONE *free of charge. Advertiser must send 25 cents to pay postage, if replies are to be addressed in care of* STONE *Rate to non-subscribers, 10 cents per line each insertion.*

WANTED—Position; 16 years' experience as foreman and superintendent in general contract work, quarries and heavy masonry; expert on broken ashlar work. First-class references furnished. Address J. B. GORDON, Roscoe, New York.

A MAN who is thoroughly acquainted with the Granite Business in all its details, having an experience of 15 years, wishes to correspond with reliable wholesale manufacturer or quarryman regarding a situation, either for road or office position, after January 1, 1899. Correspondence confidential. Address G. B., care of STONE.

SITUATION WANTED by Architect and Monumental Carver; one who can do general work; 18 years experience; young married man. Address R. H. MOONEY, Harvey, Ill.

TO SELL. TO BUY. TO EXCHANGE.

Advertisements inserted in this department for 15 cents per line each insertion.

FOR SALE—Blue Stone Quarry, located Summit, N. Y., 37 acres; also steam drill in good condition. separate or together; price low. For particulars address T. H. MAGILL, Troy, N. Y.

FOR SALE—Limestone Quarry, 12 acres, situated on Railroad. 2 Engines, crusher, etc. Grain business in connection. Operated 13 years. Address ARTHUR Z. CARON, Carrow, Ill.

FOR SALE OR LEASE—GRANITE QUARRY, on tide-water at Occoquan, Virginia, 25 miles from Washington, equipped with modern machinery and appliances and ready for work. Also VALUABLE WATER-POWER; fall of 50 feet; full flow of Occoquan River, drainage area of 500 square miles. T. H. PHILLIPS, 40 North 7th St., Philadelphia, Pa.

FOR SALE OR LEASE. Quarry of the Rock River Brownstone Co. near Marquette, Mich. Will sell or lease this property on a royalty, Machinery for operating on the premises. Correspondence solicited. Address W. I. BROTHERTON, Bay City, Mich.

WANTED. Having an extensive deposit of Brown and Blue stone, pronounced by some of the best architects and dealers as superior in quality and color, would like to meet party with practical experience and some means with the view of developing same. This stone is situated above water level, little or no stripping, on main line, railroad with low freight rate to all points. Further particulars can be obtained by addressing B. & B. STONE, 1220 Filbert St., Room 45, Philadelphia.

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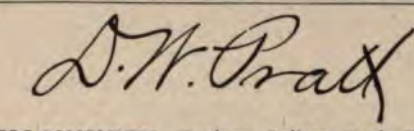

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General Trade Miscellany

Talc and Soapstone.

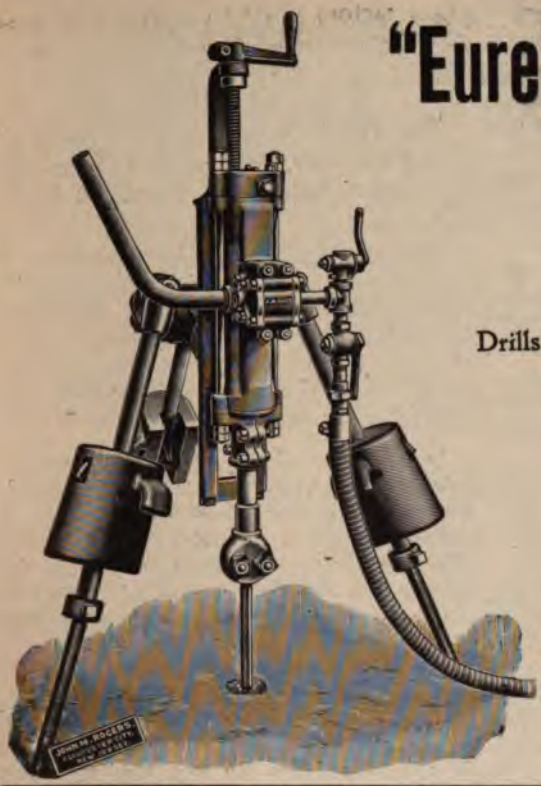
The production of talc in 1897 was 49,395 short tons, against 79,319 short tons in 1896. The output in 1897 was divided as follows: Common talc, 9,775 tons; soapstone, 7,200 tons; fibrous talc or agalite, 32,420 tons. There was a large falling off in the production of the last, of which in 1896 the output was 45,000 tons. Our classification of "common talc" and "soapstone" differs from that of previous years, in which both were grouped as "soapstones." This, however, failed to represent the actual industrial conditions, since pure talc, which we have now designated as "common talc," is used for entirely different purposes and commands a considerably higher price than the material which is mineralogically an impure talc, and is known commercially as soapstone, under which title we have entered it. Common talc and soapstone were produced in the United States in 1897 in Vermont, Pennsylvania, North Carolina, Georgia and Virginia. A new deposit of much promise was opened in Vermont. The production in other states was derived from the same mines as heretofore. An interesting feature of the year has been the exportation of North Carolina talc and its reimportation under the name of French talc. A good deal of the mineral product in North Carolina is exceptionally pure in quality, and without doubt equal to the best grade of French. It is prevented from standing upon its own merits only by the trade prejudice in favor of the name "French talc." The production of fibrous talc was derived entirely, as heretofore, from the mines in the vicinity of Gouveneur, St. Lawrence county, New York. This material is ground and used chiefly in the preparation of non-conducting coatings for steam attributed to the growing disinclination of paper makers to use this mineral as a filler, since even the best grades contain a little grit. China clay and other material appear, therefore, to be gradually replacing fibrous talc in paper making.

Counterbalancing Hoisting Ropes.

When the sinking of shafts becomes very costly, as is generally the case in Westphalia, all the space in the shaft is so valuable that any method of balancing the mining rope that requires separate shafts or compartments should be rejected, observes General-Director Tomson. The use of a counter-weight traversing a reduced path is only feasible for slight depths; and the same may be said of balancing systems which are based both on the variability of the winding-up radius and on the use of a counter-weight moving, either in the winding shaft or in a separate shaft, for a vertical distance inversely proportional to its weight. A method proposed by M. Godin, which is rational, if rather complicated, consists in counterbalancing the winding engine by storing up the rope during the last part of one lift, and giving it back again in the first part of the next. The work, at times in excess, may be utilized in compressing the air in receivers, or increasing the pressure on water under an accumulator, to be afterwards restored to the engine.

Origin of Limestone Ballast for Railways.

Crushed limestone was first used by the Pennsylvania System of railways in the construction of beds for tracks. The stone was tried as an experiment, the many limestone deposits along the Pennsylvania Lines in eastern Pennsylvania suggesting its use in that manner. It was



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found to pack solidly and make a remarkably firm roadbed, besides being clean and offering no nourishment for weeds. Limestone ballast is now used extensively on the Pennsylvania System throughout Pennsylvania, Ohio and Indiana, which accounts for the smooth running of trains and freedom from dust enjoyed by passengers over that route.

Montana's new capitol will be one of the finest in the western mountain states and is expected to be ready for occupancy by 1900. It will be built of sandstone secured in the mountains near at hand, and of excellent quality. The contract was let to the Montana Building company at something like $300,000 and according to the plans will be of a most modern style and equipment. Every convenience will be afforded and the entire structure put up on lines that look to the simplification of conditions and a general saving of space and expense. Architectural experts have pronounced the plans to be the best that have ever been offered in that country for a similar purpose and every requirement seems to have been met. The work has begun on the foundations, but it is likely that there will be little done this winter beyond getting out the stone from the quarries operated by the state.

There is a sandstone quarry in the high river bluffs near the penitentiary in this city, says the Sioux Falls, S. D., Leader, that may some day prove richer than a Klondike gold mine. Some of this stone is hard as brick bats, (?) while the greater portion of the face of the quarry is composed of a stone so soft that it will readily crumble between the fingers, and the sand of which this portion is formed is of the finest and sharpest character. The uniform size of the particles is remarkable—in line with their sharpness, hardness and grit. The point to all this is that the quarry presents an opening for a sand paper factory in Sioux Falls. City Auditor Estabrook, the originator of this idea, was experimenting, in a rude way, in the manufacture of a sample of sand paper from this soft rock. Perhaps there's something in his discovery, and it may be a pretty big thing at that. A sand paper factory could be operated here as there is yet no sandpaper trust in existence.

The Hard Stone Cutters' union of Louisville, Ky., has seceded from the Knights of Labor and joined the A. F. of L.

Charleston, S. C.—At last there is prospect of the kaolin deposit in middle Chesterfield being developed. Northern parties are negotiating for the purchase of the "mountain" known as "Sugar Loaf," and before long will probably be operating the works.

During 1897 there were 1,015 separate fatal accidents in and about all the mines and quarries, more than 20 feet deep, in Great Britain, involving the loss of 1,102 lives, showing, on comparison with the previous year, an increase of eleven in the number of accidents, and a decrease of 86 in the number of lives lost.

E. G. Kemper has brought suit at Burlington, Iowa, against Capt. Kirchner of the government contracting fleet for $1,000 as redress for not abiding by a contract entered into by him. He claims that the stone quarry, which he owns and the defendant used, was not left in the condition Capt. Kirchner promised it should be.

The once thriving town of Glen Eyre, Pike County, Penn., was recently sold by the sheriff at Milford, to Peter B. Vermilyea, a lawyer of New York City. The attorney, it is said, purchased the town for Mrs. Mary T. Carpenter, of Scarsdale, near New York City. The sale was made for $7,600, which amount is over $1,000 above debts and cost. It is stated that the new owner of Glen Eyre will endeavor to restore the lumbering and stone quarry business and if possible build the town to its once former prosperity. Glen Eyre was formerly owned by Mr. and Mrs. John Deming. The sale includes the whole village. The land measures about 842 acres, 50 of which are improved. The village proper occupied only a few acres and contains about fifteen dwelling houses, a railroad

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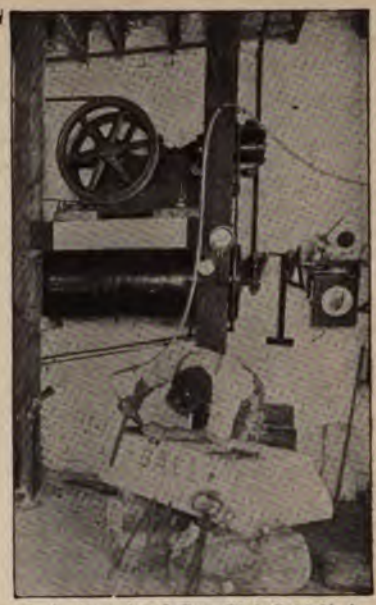

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depot, three shanties, two barns, storehouse, sawmill, post office, blacksmith shop, factory building and other buildings.

The curb stone cutters' union has prepared a petition to the legislature asking that a bill be passed requiring Detroit to buy curbstone from the quarries and to hire cutters to dress it without the contract system.

The old Abbott quarry at South Elgin, Ill., owned by the South Elgin Stone company, contains a fish of an enormous size. Some say it is a catfish weighing forty pounds. Many of the old-time river men are trying to solve this fish problem. This monster of the finny tribe has been seen flopping lazily in the water. The stone company expect to work this quarry before long and when this time comes there will be a scramble for fish, especially for the big fellow.

The stone quarrying enterprise four miles below Salida, Colo., is developing into quite large proportions. The best stone is to be used for building purposes and the broken stone for lime. A large crusher is at work and stone for paving purposes is being prepared. A spur from the railroad runs into the quarry and provision for economical handling of the quarry product has been made. There are now twenty-five men at work, and when everything is properly opened up and under way 100 more will be employed.

Brigham City, Utah.—While up in the vicinity of Weston, Idaho, M. M. Faulkner of this city states that he recently visited a hill about four miles northwest of that village which bears evidence that a race of people, in ancient days, lived there who were skilled hewers of stone. The hill contained stone laid together in square pieces and between each layer is a substance resembling crumbled mortar or cement. The stone is nearly white and very hard. He says the present inhabitants build their houses or foundations from this rock, and never need to trim it, it being so perfect in shape.

West Chester, Pa. The affairs of the insolvent Avondale Marble Company received some attention in court when President Judge Joseph Hemphill handed down an opinion decreeing that Director James Brown, of Williamsport, must disgorge 1,250 shares of stock alleged to have been fraudulently issued.

About a mile north of Bloomingdale, Wis., a field of several acres is covered with huge sandstones of a light grayish color and of medium firmness. Some of them are as large as houses and were brought down by glaciers in prehistoric times. There are no other stones of like character in this section of the country. These stones are being quarried for building purposes.

This proceeding was instituted by Philip S. Vollmer and others and was directed against R. H. Hepburn, G. D. Tinsman, James Brown, the Avondale Marble Company and G. D. Tinsman, the treasurer, the allegation being that James Brown, one of the defendants, is unlawfully in possession of 1,250 shares of the Avondale Marble Company belonging to plaintiffs, and the prayer being that the defendants be restrained from transferring the same and be ordered to surrender the same for distribution among the persons entitled thereto in accordance with their respective interests.

Says Judge Hemphill after reviewing the case: "From the facts it would seem clear that Mr. Brown has no right, title or claim to this certificate; he was not a purchaser for value, nor was it assigned or even delivered to him as collateral for money loaned by him. He is in possession of it solely because he had an opportunity to seize it and did seize it.

"The scheme for the reorganization of the company having been abandoned, the ownership of this stock is vested in those who assigned the same to R. Hope Hepburn, and they are entitled to have their certificates reassigned to them, or, if lost or destroyed, new ones issued to them in their place, and to have the certificates for 1,250 shares held by Mr. Brown surrendered to and canceled by the company.

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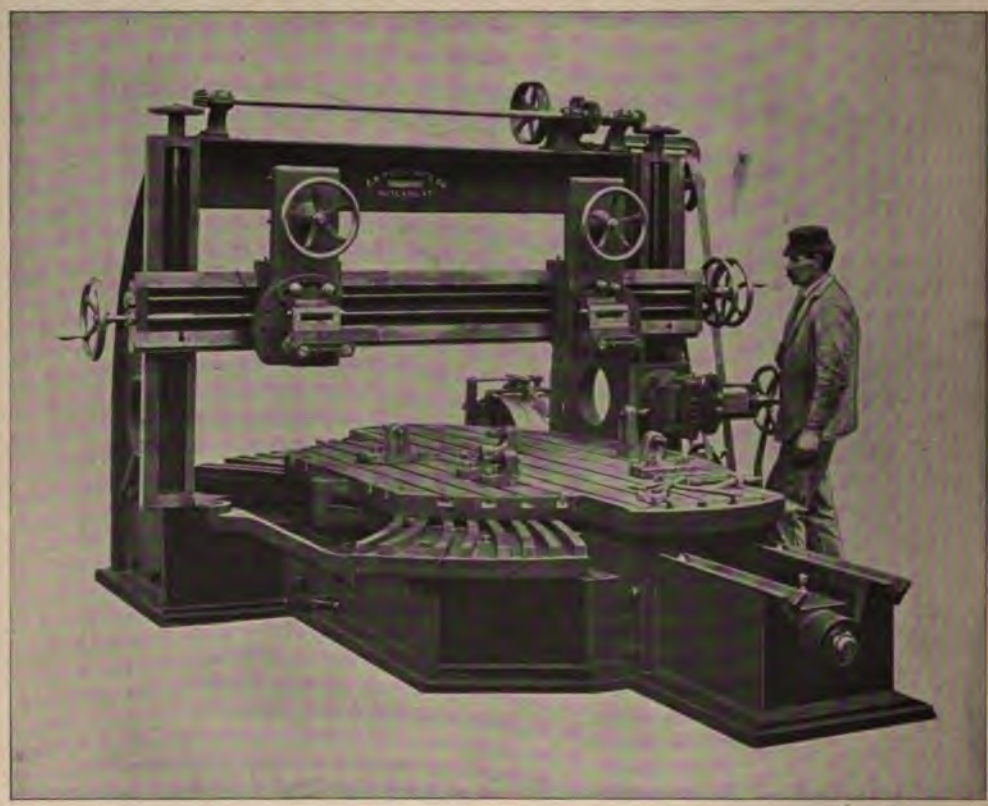

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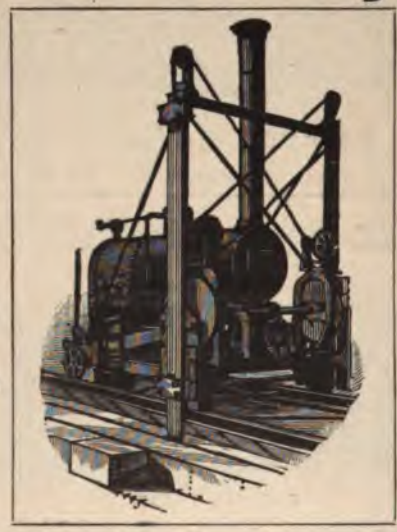

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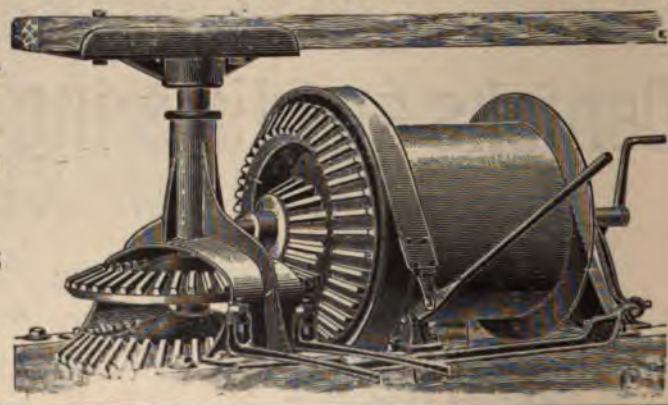

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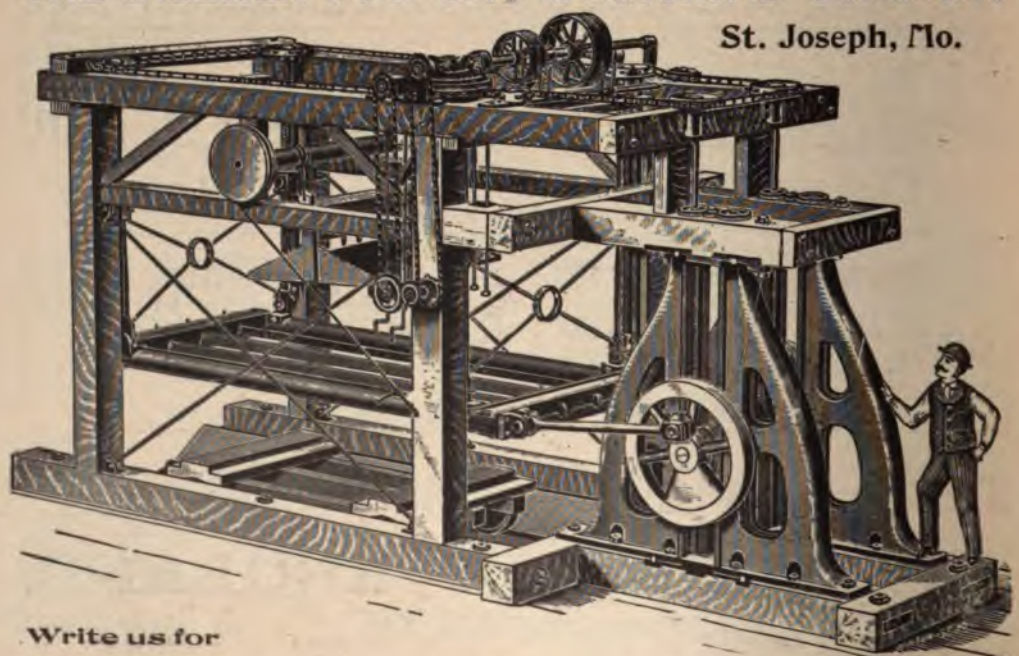

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STONE.

NUMBER 4.

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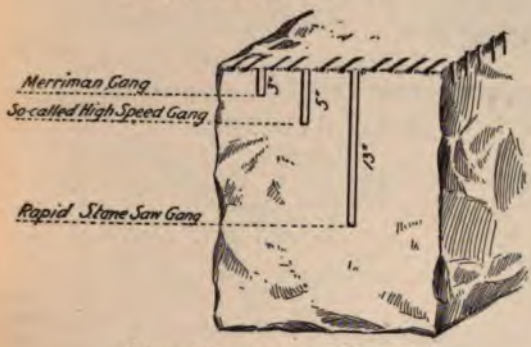

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STONE

VOLUME XVIII. MARCH. NUMBER 4.

"STONE" IN A NEW HOME.

WITH this issue STONE makes its appearance from a new home and under a new management. The undersigned has purchased the business and good will of the magazine from The D. H. Ranck Publishing Company, of Chicago, and has removed the publication offices to New York City. This change in location has been urged for some time by the closest friends of the magazine. It is believed that its field of usefulness will be enlarged and that it will be brought more closely in touch with the great centers of production, as well as with the centers of distribution. Aside from these considerations, which are largely a matter of convenience to the publisher and his readers and patrons, the change will have no special signification. STONE will continue to represent the allied industries for which it stands without sectional bias, and every effort will be made to cover the entire field. There will be no change in the general policy of the magazine, although new features will be introduced from time to time.

STONE was founded more than ten years ago by Mr. D. H. Ranck, and this gentleman has guided its destinies ever since then up to the present number with singleness of purpose and high resolve. The esteem in which he is held by the many friends of the magazine is a fitting guerdon for his services. If this loyalty from its subscribers and advertisers can be retained by the new management, no greater measure of success can be asked. To deserve this friendship and loyal support will be the guiding principle of the publisher. Counsel and advice to this end are earnestly sought from all who read these pages.

To remove a periodical from Chicago to New York without suspending a single issue, means a great amount of hard work. In consideration of this fact, readers of STONE are asked to view with kindly indulgence the shortcomings of the present number.

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MASONRY.*

PART II.

MORTAR plays a very important part in all except dry masonry and especially in concrete and the inferior forms of stonework. The simplest form of mortar is a well worked clay, such as adobes are laid up in, and with which the brick chimneys of many of the older farmhouses in our country were formerly built; but the use of clay has practically gone by except in furnaces and ovens where the heat-resisting capacity of fire clay is more important than the superior strength of a good mortar.

Mortars are generally formed of lime or cement and sand. A lime mortar does not set but hardens slowly. A cement mortar sets quickly and then continues to harden. The hardening of the lime mortar is a slow chemical action between the lime and other elements; the best results are obtained by mixing the mortar some weeks before it is used and not subjecting it to any great strain till a considerable time after it is laid. The action of cement is different; the cement itself contains all the elements necessary to the setting and hardening; a briquette of pure cement will set harder and be stronger than a briquette containing even a small portion of sand. The function of sand in a cement mortar is simply that of a dilutant and is precisely similar to that of broken stone or coarse gravel in concrete. In a cement mortar there should be enough cement to fill all voids between the grains of sand, which implies a coating of the entire surface of every grain, and enough more than this to provide for the contingency of imperfect mixing. The more perfect the mixture the less the amount of cement that will be required, and the finer the cement is ground the less cement it will take to coat every particle of sand.

In both lime mortar and cement mortar the best results are due to work; the more complete the incorporation of the ingredients the better the mortar will be. In lime mortar, which hardens slowly, time need not be considered and this incorporation can be done slowly. In cement mortar where a set takes place early it is important that too much time should not be spent in mixing. In the alluvial deposits of the Ganges is found a kind of limestone of irregular shape known as kunker; the Hindoos make a mortar of kunker, lime and brick dust which becomes as hard as Portland cement; the piers of the great bridge across the Ganges at Benares are laid in this; its excellence is due to work. A similar excellence is

*Extracts from a paper by Geo. S. Morrison, Member Western Society of Engineers. Read October 21, 1898. Reprint from Journal of Society.

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FIG. 10.—THE CABIN JOHN BRIDGE, WASHINGTON, D. C., AQUEDUCT, LONGEST MASONRY ARCH IN THE WORLD.

found in all their mortars; when the lime has been slacked they grind it in a hand mill, then they grind the sand in a similar mill and then they grind the lime and sand together, all of this work being done by women; the mixture is then wet and ground in a mortar mill with bullocks and when it is used it is pounded for hours. They will take this mortar, plaster a wall, pound it and rub it down and the final result of their patient work is a plastered wall, with a polished surface as smooth as that of porcelain, which will stand the weather of their frostless climate for more than a century. The secret of good mortar is work; in India, where labor is hardly worth five cents a day, this can be done by hand; in this country we cannot afford it; it is cheaper to use the most costly cements, but even cement mortars are better if thoroughly worked, and I hope to see the time when machine mortar mixers are as common on masonry walls as power riveters are now in bridge shops.

As the capacity of masonry is limited, so are also its uses. Its use must conform to conditions of stability without tension and this necessarily limits its applications. Masonry is an art by itself; the laws of its construction are complete in themselves and the best masonry is found in those countries where other structural methods do not generally prevail.

The Japanese, who have preserved and cared for their forests, are exquisite carpenters and nearly all their buildings are of wood; their temples are the most elaborate specimens of timber construction that can be found. On the other hand, their country is subject to frequent earthquakes and masonry has been but little used. Their constant use of timber has led to building structures which are absolutely absurd; they have applied the principles of timber construction to stonework; there are bridges in Japan which are supported by bents composed of stone posts tied together by horizontal stones which pass completely through the posts; at the entrances to their temples are stone gateways, made of framed posts and caps, which look like wood;

all this is bad. One of the strangest designs that I have ever seen was that of a monument to be erected in the capital of one of our larger States; externally it appeared to be a decorated piece of solid masonry, but internally it was a stone frame based on lines properly adapted to timber construction. It had been selected from several designs by a board of architects, but fortunately was submitted to an engineer before it was built.

The first and simplest use of masonry is as a support to carry weight, as in a column or a bridge pier. For this purpose it is an absolutely appropriate material and the satisfactory results which have been obtained are illustrated by the heavy columns of the ancient Egyptians, by the exquisite work of the Greeks, and the slender shafts which preserve to this day the beauty which we imitate but do not equal. For bridge piers masonry is by far the most suitable and best material. An ordinary truss bridge is so designed that practically no horizontal strain is imparted to the masonry which simply carries the weight imposed upon it. If made of good stone, masonry is better able to resist the action of water and air combined with changes of temperature, than anything else. A bridge pier should be built of ashlar masonry with horizontal beds and well bonded stones. Rubble backing may be used if thoroughly filled with first class mortar, but a backing of stones, with horizontal beds, of the same thickness as the face stones is better. The following clauses, which illustrate the class of work which I have preferred to use, are taken from the specifications for the bridge across the Missouri River at Bellefontaine Bluffs:

Each bed of every stone shall measure at least 26 inches in each direction, except that where the thickness of the course is less than 24 inches the bed need not exceed one and one-half times the thickness of the stone.

The bottom bed shall always be the full size of the stone and no stone shall have an overhanging top bed.

Stretchers shall not be less than 4 feet nor more than 7 feet long, and stretchers of the same width shall not be placed together vertically, but this

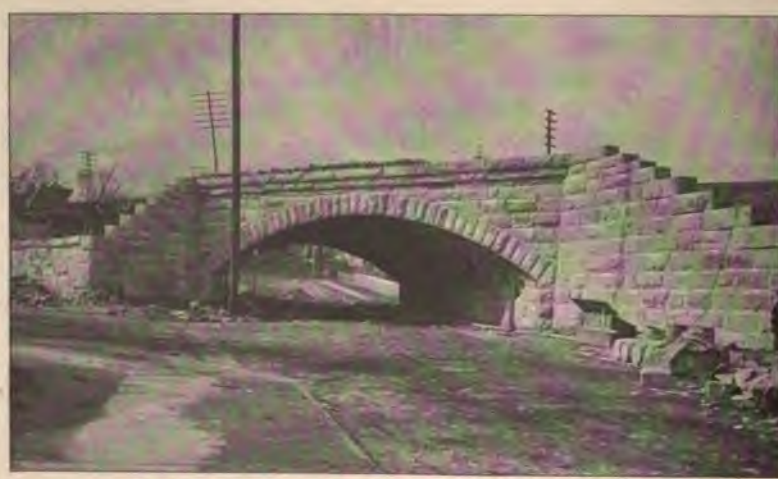

FIG. 11.—RAHWAY AVENUE ARCH, PENN. R. R. ELIZABETH, N. J.

shall not apply to the ends of stretchers where headers come centrally between stretchers.

Headers shall be at least 5 feet long, and shall be at least three-quarters their full width for the whole length. There shall be at least three headers on each side of every course between the shoulders.

Joints shall be cut vertical and at right angles to the face of the stone unless otherwise shown on special plans. The cutting for at least 12 inches back from the face shall be the same as that required for the beds.

Joints shall be broken at least 15 inches on the face.

The backing shall be composed of stones of the same thickness as the face stones, with beds cut in the same manner as required for the face stones and with no overhanging top beds. The spaces between the large stones shall not occupy more than one-fifth of the entire area of the pier inside of the face stones, and these spaces shall be filled with good rubble masonry carefully laid up in full mortar beds and well rammed.

A bridge pier has two functions; it must carry weight and it must pass water with the least disturbance to that water. This calls for the same kind of lines that are needed in a boat; corners are to be avoided and the best results are obtained by piers which are pointed at both ends but have no other angles. The form of pier which I have found to give best results has straight parallel sides terminating in circular curves, to which the sides are tangent. A considerable variation can be allowed in the radius of the end curves, but a radius equal to about three-fourths the thickness of the pier gives very good results. The down-stream end may be made semi-circular without seriously injuring the form, though it creates more disturbance in the passage of water. Sometimes a semi-circle may be used at the up-stream end, but in rivers carrying any considerable amount of drift this is liable to cause trouble. A common form of pier is hexagonal, with parallel sides, a right angle at each end and an angle of 135 degrees at each of the four shoulders; this, however, is not a good shape as the angle at the shoulder is sharp enough to make a great disturbance in the passage of water. Nearly twenty years ago I adopted a plan of bridge pier which I have never thought fit to change. The cross section between high and low water is of the kind which I have described; above high water the ends are made semi-circular; the pier is finished with projecting coping and a belting course under it on top, and the offsets near high water are covered by small copings. The pier is very plain, but is perfectly adapted to its purpose and always looks well. It is perfectly symmetrical so that the pressure on the foundation is as nearly as possible uniform. In low bridges where the piers finish but little above high water no change in shape is made. The long raking ice breakers which were formerly popular are rarely needed with heavy piers of good masonry; when used they necessarily throw the center of pressure outside of the center of masonry and make unequal weights on the foundation.

Another proper use of masonry is that of retaining walls, including the abutments of bridges. The duty of a retaining wall is double; it has to carry its own weight as well as any weight that may be put on it (like the superstructure of a bridge when it is an abutment), and it has also to resist the horizontal thrust of a mass of earth behind it, the resultant of the horizontal and vertical strains being a curve more or less inclined. To produce the best results the masonry should be laid up in inclined courses, the joints being

FIG. 12.—OAKLY ARCH, SKEW 42 DEG. 30 MIN.

everywhere normal to this resultant curve; in some cases this has been done. The wall must be so proportioned that the resultant curve shall never pass outside of the middle third, and this means that the weight of the masonry, which acts downward, must be greatly in excess of the thrust of the earth-work which acts horizontally. The principal duty, therefore, of a retaining wall is to provide weight and a large amount of cheap masonry may be better than a smaller amount of first class masonry. Good rubble masonry and concrete are excellent materials for retaining walls. One of the most satisfactory retaining walls I have known was built of concrete, made with Louisville cement and faced with a single thickness of brick, the brick being bonded into the concrete by making every other brick a header in every second course. There is no class of structure, the determination of the strains in which is more uncertain than a retaining wall. The principal difficulty lies in the uncertainty of the thrust of an earth embankment which varies with the amount of saturation, by the method in which it is made and by irregularities of both time and place. It is perhaps as safe to follow arbitrary rules as to make close calculations; a common rule being to make the thickness of a retaining wall never less than 40 per cent. of its height above such thickness; with some favored soils this may be reduced to 30 per cent., but where subject to vibrations or other disturbances it should be increased to 50 per cent. It must also be remembered that nearly all foundations are compressible and that the pressure on the foundation of a retaining wall may increase from nothing at the back to twice the average at the face, which means that a retaining wall on a yielding foundation will move forward to an extent which can seldom be estimated, but which must generally be provided for.

A form of retaining wall which is free from these latter defects is the masonry dam, which instead of a pressure of earth resists a pressure of water. This is a pressure which can be calculated absolutely and the dam can be

proportioned to take care of it exactly. The design of a dam is complicated, not by uncertain data, but by the fact that the level of the water behind it may vary from nothing to the maximum height permitted by the spillway, and paradoxical though it may seem, a dam which is perfectly safe to sustain a head of water 100 feet high may have tension cracks open on the lower side when the head is only half as great. In dams, masonry is needed principally for weight, and as with the difference of level of water the resultant curves of strain are constantly changing a dam cannot be so designed that the beds of the stones shall at all times be normal to the resultant curve of strains. There is little advantage in using ashlar masonry in a dam, and the best dams are built of rubble or of concrete; but it is very important to use thoroughly good mortar and to make sure that all the voids are filled, as openings mean leakage. One of the great dams of late years is the Tansa built for the Bombay Waterworks; a dam 118 feet high, built of rubble laid in kunker lime mortar made with the patient excellence already described.

The problems of the builder early called for the covering of openings between pillars and over doorways and then for the complete covering of rooms. It was solved by the use of lintels and architraves, single stones being used as beams. Where rooms had to be covered, if they were not too large the same method was followed; this was common in all the ancient Egyptian work.

The spanning of openings with masonry is not, however, limited to small dimensions and the form of construction most available for large spans is the arch. In columns and piers the only strains to be resisted are those of gravity acting in vertical lines. In retaining walls and dams these strains are combined with horizontal pressure producing inclined resultants. In arches, weights which originally act only in vertical lines, being carried outside of the lines of support, necessarily involve inclined resultants, which introduce horizontal strains. Without going into the theory of catenaries it may be briefly stated, that a loose cord fastened securely at each end has some form of stability for every loading which can be put on it, the cord, however, always being in tension; that if this curve, which is stable for a particular load-

FIG. 13.—ARCH OF SEPTIMIUS SEVERUS.

ing and no other, is inverted, it is stable for the same loading but is in compression and not in tension; but though the cord in tension by changing its shape for every change in loading preserves its stability, the inverted catenary in compression would go to pieces with a very slight change of load. Furthermore, the shape of the catenary will adapt itself to the amount of slack left in the cord; the intensity of the strain is roughly proportionate to the amount of the deflection below a line connecting the two points of end attachment, and the same is true of the inverted catenary in compression. A masonry arch

FIG. 14.—ARCH OF CONSTANTINE.

should act only in compression and the strains in it are those existing in the inverted catenary. For every loading there is some form of arch that will correspond exactly to the curve of strain. For every form of arch there is some loading which will correspond exactly to its shape. So long as the curve of strain does not pass outside of the middle third of the arch, the arch is perfectly stable and no tension occurs anywhere in the masonry. The masonry of an arch should be so laid that the joints are everywhere normal to the curve of strain, this being the direction in which the pressure acts. The perfect form of an arch which is to carry a variable load of which a portion is permanent or static and a portion moving, like a railroad train crossing a bridge, is one in which the curve of permanent strain follows the center line of the masonry and the curve, as modified by the different positions of the moving load, never passes outside the middle third.

An arch is entirely without stability until it is complete; it is self-sustaining only when the pressures are carried across from one side to the other, these pressures being horizontal at the crown. An arch, therefore, must be supported by something else than itself during construction, and this is usually accomplished by building it on a timber form known as a center, the center carrying the weight of the arch until the last voussoir, known as the keystone, is put in; when it is placed the centers are struck and the arch settles slightly, as the joints for the first time take the pressure due to the weight. There is always a horizontal pressure at the keystone and this must always be balanced by an equal horizontal thrust at the spring of the arch. Where several arches are built together the thrusts of successive arches will balance

each other and they may be supported on thin piers proportioned only to sustain the weight. But in the case of a single arch or of the end arches in a long arcade, the piers must be made heavy enough to resist this thrust. In other words, they must be of such dimensions that the combination of this horizontal thrust, with the vertical action of weight, will never fall outside the middle third.

Arches are built of various shapes; one of the commonest and most beautiful forms is the full centered arch—that is, the arch is itself a half circle. This is the form usually adopted for monumental work; it is, however, a form which requires very careful treatment; if the filling above the arch is built up solid, the weight distributed over the arch does not correspond to the form of the arch and rupture is likely to occur in the haunches; this is obviated by using a hollow filling over the haunches, which may be accomplished either by cellular construction, or, better, by building up the spandrels with cross walls supporting small arches.

A favorite form, and in many respects the best, is the segmental arch—that is, an arch which is a segment of a circle, the preferred dimension being one in which the rise is one-quarter the span. With these proportions there is less difficulty in conforming the load exactly to the curve of the arch. Another form is the elliptic arch, which is usually not a true ellipse but formed of either three or five circular arcs. As commonly built the elliptic arch is really a segmental arch with the angle at the skewback filled out. To these may be added the pointed arch, which is characteristic of Gothic architecture and an endless variety of parabolic, hyperparabolic and other special shapes.

The essential characteristic of an arch is that it should act only in compression resisting the strains, which follow the curve produced by weights, by compression only, this implying a thrust at each end. This thrust can be taken by tension rods of metal, but in monumental structures should be resisted, like the thrust of the earth against a retaining wall, by the weight of the masonry. These features of construction are absolutely necessary; without them, whatever the shape, no arch exists. People who are influenced by the vagaries of amateur art talk of finding the Gothic arch in the meeting boughs of overhanging trees or find the circular arch in the bent sapling with which a savage constructs his rude hut; both ideas are absurd. The first arch was built when two inclined stones were first balanced against each other; such an arch may still be seen at the entrance to the passage leading into the great Pyramid. The next step was to use three stones instead of two and from this progress was rapid to the perfect arch. To understand an arch, it is absolutely necessary to remember what it does and the duties of overhanging trees or of bent saplings are entirely unlike the duties of an arch.

Besides the simple arch which we may say is in one plane only, the principles may be adapted to a great variety of constructions. An arch may be used to connect two supports or piers which are not at right angles to the line of support; this makes a skew arch. This form of arch is perfectly correct and stable provided the voussoir joints are made at right angles to the curves of strains, which curves are in planes parallel to the center line of the arch and not at right angles to the direction of the piers. A simple way of meeting this result is to build a series of narrow square arches, the successive

arches making offsets corresponding to the tangent of the angle of the skew. This simplifies stone cutting, but it is not necessary and the laying out of the correct voussoir lines for a skew arch is an excellent exercise in masonry designing.

If two arches of considerable width intersect each other they form a groin, this combination being known as a groined arch, the simplest form being that in which two arches of the same dimensions cross at right angles, but the same principle may be applied with arches at various angles and of various dimensions. Gothic architecture probably had its origin in the groining of the narrow arches of the aisles with the larger arch of the nave, the pointed arch accommodating itself to those conditions. Groined arches are adapted to a great variety of uses and might be applied to many structures where other methods are commonly used. An excellent form of flooring for fireproof buildings is made by a series of flat groined arches resting on columns spaced at equal distances in both directions, the thrusts of the arches balancing each other and the whole floor requiring no metal work except horizontal girders around the edges to take the thrust of the outside arches, and these horizontal girders may be so buried in the floors as to be very light.

There is a form of construction which looks like an arch but is not one. The most beautiful architecture since the days of the Greeks is that which was carried by the Mohammedan conquerors as far west as Spain and as far east as India; the architecture with swelling domes, with arches apparently more than full centered, finished in fantastic and graceful shapes. In reality there are neither arches nor domes in this architecture; everything is laid up in horizontal courses, the stones being corbled out over each other. It is a construction entirely without horizontal thrusts which permits of the slender columns and graceful forms which characterize this beautiful work.

The arch should be used cautiously in monumental works. The fundamental idea of a monument is indefinite duration; it is built to commemorate some event; it is to be the eternal record of that which has itself passed; it should also be a pleasant thing to contemplate. The idea of indefinite duration is agreeable only when coupled with an idea of rest. The nirvana of the Buddhist is the most soothing of ideas; the labors of Sisyphus were the most

WASHINGTON ARCH, NEW YORK.

FIG. 15.—AS IT SHOULD BE. FIG. 16.—AS IT IS.

excruciating of tortures. Structurally the idea of compression is one of rest, as when the whole weight of the body is supported; the idea of tension, which calls for muscular resistance, is an idea of strain. It is said that the ancient Egyptians never used the arch because it did not comport with the feeling of rest which characterized all Egyptian architecture. This is hardly correct; even an Egyptian pyramid does not typify rest more than a stone arch thrown across a mountain gorge. The feeling of strain does not come from the arch

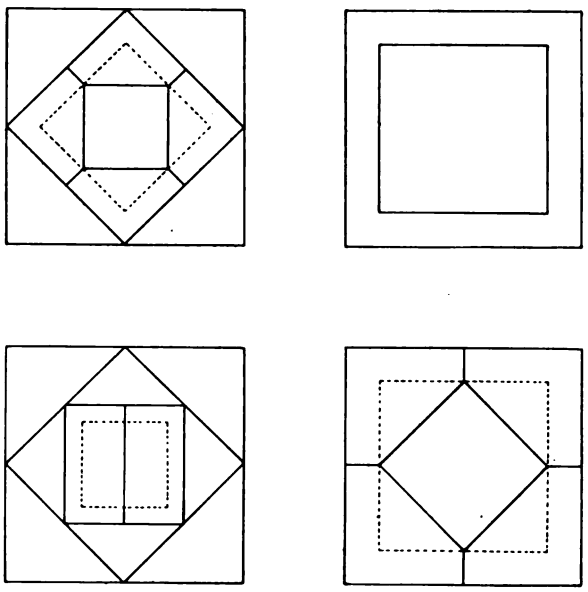

FIG. 17.—INDIA ROOF COVERING.

itself, but from the apparent effort of the abutments to resist its thrust; and in a monument this appearance can be removed by making the abutments of such dimensions as not only to resist the strain, not only to bring the resultants within the middle third, but to give such a superfluity of material that the idea of effort never occurs to the observer. This rule should not apply to the various buildings and other works which serve pre-eminently a utilitarian purpose, but it does apply to all monumental work. The Romans built triumphal arches, and, though the special ceremonies which they commemorate have passed away, they are still built. The Roman arches were not all handsome. In the arches of Constantine and Septimius Severus the arch occupies only about one-quarter of the length; each abutment is one-half thicker than the span of the arch; these arches are true restful monuments. In the arch of Titus the proportions are different, the thickness of each abutment being about three-quarters the span of the arch. The great arch in the Place d'Etoile in Paris is one of the finest ever built. The arch in Washington Square, in which the thickness of the abutment is only one-half the span, is one of the worst.

The arch, whether in simple or complicated form, is not the only method of spanning large openings with masonry. A method is found in India by

which openings are covered by stones much smaller than would be required to reach completely across the opening, the stones being laid across the corners of a square leaving open another square just half the size of the first, the system being repeated until a square is obtained small enough to be covered by stones reaching completely across. Such methods of using stone, however, while interesting features of masonry construction, are very simple, and as they are only adapted to small dimensions, they call for little consideration from engineers. Another method is the dome. The dome seems like a modification of the arch, being, as it were, the solid produced by the rotation of an arch. The dome, however, is not an arch but a construction of very different character, the strength of which is determined by different conditions. An arch is self-sustaining only when it is complete; it must be supported in some other way until the keystone is placed. A dome has no keystone; the central portion may be entirely omitted without impairing its stability; it may be built up without false work; each successive ring is completely self-sustaining as soon as it is built; it is only necessary to support the separate stones or bricks of each separate ring until that ring is completed and there are various simple devices by which this can be done. This element of stability in a dome is understood when it is remembered that neither an arch nor a dome can fall unless it falls forward from its support; in an uncompleted arch there is nothing to prevent this; an uncompleted dome cannot fall forward without diminishing its diameter, and the diameter of a circle of masonry cannot be reduced without crushing the material of which it is made. At its base the dome exerts a thrust outward in every direction, but the thrust inward toward the center is resisted by a horizontal circular arch.

But though the dome requires no keystone, its weight must be carried downward from the axis toward the circumference where it is supported, and the weights of a dome carried down in this way produce, like those of an arch, a resultant curve. This curve represents only the strains in plains radial to the axis and does not include any of the circumferential strains by which the dome is always self-sustaining. This resultant curve is dependent on two forces, the vertical action of weight, and the horizontal strains which are resisted by the circular form of the dome. The weights are known quantities; the resultant curve may be assumed to be in the middle of the masonry; in other words, to conform to the curve of the dome; the problem is the determination of the horizontal strains with the vertical weights and the resultant curve given; this can be done graphically or by analysis. When these horizontal strains represent forces acting toward the center, the dome is stable; if, however, they represent forces acting outward, the dome is unstable and will burst unless held by a metallic band. Two classes of strains will always exist; those following the vertical curve of the dome; circumferential strains which are everywhere equal to the radial horizontal strain multiplied by the horizontal radius of the dome in the same plane.

As in the case of the arch, a form of dome may be found which corresponds to every condition of symmetrical loading and a form of loading may be found which corresponds to every form of symmetrical dome. The forms and loadings, however, vary greatly and many forms of stable domes are excluded by the inconvenient shapes which they involve. Furthermore, any

dome may be made stable by strapping it with iron at the place where it tends to rise, a method which has been often adopted in domes which are supposed to be entirely of masonry.

A dome of uniform thickness is always stable when the height does not exceed one-quarter of the span, but such a dome would at once become unstable if loaded with a heavy central lantern. It is a significant fact that low domes of this proportion are almost always pleasing to the eye. The dome

FIG. 18.—REPRODUCTION OF THE PARTHENON AT THE TENNESSEE CENTENNIAL.

exerts an outward thrust at the base, and this thrust can be resisted in two ways, either by a weight of masonry in the same manner that the thrust of an arch is resisted or by a hoop of iron which straps the whole together. The former is the true restful method of masonry construction, the latter is a mechanical device perfectly proper in utilitarian construction, but wrong in monumental work. And this leads to a suggestion of a class of domes which can be used for many purposes and be very effective. If a dome be built of concrete with a series of parallel steel rings imbedded in it, it will be able to resist both tension and compression horizontally throughout, and can neither rise nor fall. Such a dome could be built very light, and could be made of almost any symmetrical shape. Various details of construction could be introduced which would admit light through such a dome and it would form an admirable covering in many large rooms.

Domes have generally been built of circular horizontal section. Half domes, however, are equally stable if provision is made for taking the horizontal thrusts on the terminal diameters. This can be done by turning an arch of the same curve between the two half domes or by other more complicated methods. A room of the form of a rectangle with semi-circular ends can be covered by two half domes over the semi-circles and an arch over the rectangle, *the arrangement* being perfectly stable, provided the walls are

heavy enough to resist the thrust of both domes and arch, the latter being the more intense.

A dome may be made of elliptical section which would be perfectly stable and entirely satisfactory, but it would require varieties of loading, which would vary the horizontal thrusts to conform to the eccentric shape. It is an interesting problem to work out.

Neither the dome nor the arch is found in the oldest masonry. The arch undoubtedly preceded the dome. The true study of architecture is the mastery of the principles involved in the arch and the dome. The home of the dome was on the Mediterranean; it was used by the Romans; it was carried to its highest perfection in the Eastern empire; it was developed in the days of the Renaissance, and it was brought by the Spanish conquerors to America; it is perhaps the highest development of masonry construction.

The really fine domes are comparatively few; many of those which are best known are humbugs, more false than the false arches of the East, in that they are made of wood and pretend to be entirely unlike what they are. The upper portions of the famous domes of St. Mark's at Venice are of wood; the dome of the Invalides in Paris is of wood; the outer dome of St. Paul's in London is of wood, the lantern being carried on a brick cone inside. The dome of St. Peter's at Rome is of stone, but it proved unstable and had to be strapped with iron. These modern humbugs are poor things compared with earlier works. The dome of the Pantheon in Rome is perfect, with its central opening to the sky and bound by the weight of the massive circular brick walls. The development of the dome reached its highest perfection in the sixth century, when in the capital of the Eastern empire was erected the great church, which, after serving for nine centuries, as a Christian church, and for half that time as a monotheistic mosque, still stands, the finest specimen of ecclesiastical architecture ever built; its impersonal name being significant of the skill of its design, Sancta Sophia, the church of Divine Wisdom.

I have spoken of the general ideas and principles which should govern the use of masonry. It is the one material which is available for really permanent work. It should be massive and it must be well done. It is the most expensive form of good construction; it belongs to the class of works which are commonly associated with architecture rather than with engineering. It is the business of the engineer to build tools to produce practical results; he will, therefore, often select some lighter and cheaper form of construction which will give more immediate returns. The one material adapted to monumental work is masonry; honest substantial masonry; not a veneering of cut stone which covers a skeleton and gives a massive external appearance, which is nothing but a cloak concealing iron bands and beams within. The use of varieties of material, as an interior of brick and a facing of stone, is perfectly legitimate, provided the interior be good solid masonry throughout; but an external shell which is simply a false covering, however convenient it may be in a tool, does not belong to a monument. The great works of antiquity were built by men who knew what they were doing, though their knowledge was gained by experience and not by scientific education. With our present knowledge of materials and of the theoretical laws of strains, we should be *able to do better* work than has ever been done before. Metaphysicians speak

of the doctrine of unconscious mental modifications. It has a counterpart in something of the nature of unconscious education, by which the eye and mind, even of the untrained man, never permanently recognizes as good anything which is not built on correct lines of construction. A piece of monumental masonry which does not appear to be in a state of rest will sooner or later cry out in its trial and then everybody will see what is wrong. The construction of good masonry and its development into the noble forms of its more complicated possibilities must be based on a thorough knowledge of the

FIG. 19.—TAJ MAHAL AT AGRA, INDIA.

duties which are imposed upon it, and on this only; decoration and ornamentation must follow, not precede. The construction of such masonry may not be the work of an engineer, but it must be the work of a man educated like an engineer, and who knows how to direct the great powers of nature, if not to the uses and conveniences, at least to the monumental graces of man.

THE NEW BRIDGE OF AYR.

THE NEW BRIDGE OF AYR.

The "Twa Brigs o' Ayr" have been made famous by the poet Burns, one of the bridges being the old one in the background which is now used only for foot passage, while the new one in the foreground occupies the site of the other, the present bridge being the third to occupy the same place. The bridge consists of five spans of small rise, the side spans being somewhat shorter than the other three. The arch stones are tailed into the spandrel courses in a very pleasing manner and the keystones accentuated by a pyramidal face. The piers have rounded ends, with appropriate coping and caps, and are surmounted by counterforts with molded tops. The dentiled cornice, while very plain is of neat design, being broken over the piers by the ornamental brackets which support the pedestals of the balustrade.

The parapets or balustrades are of very beautiful design, that over each arch being divided into several sections by paneled pilasters, each section having four circular openings in the dado with other simple but effective decoration, except that the long spans have an extra panel at the center with only one opening. At the ends and over each pier there are pedestals carrying ornamental lamp posts.

The contrast with the old bridge is very great and is a striking illustration of the progress made in bridge design. Scarcely any fault is to be found with the appearance of the new bridge unless it is the lack of more prominent abutments at both ends, there being an appearance of the bridge having been crowded in between the river walls. "F."

THE BRIDGE OF THE TRINITY, FLORENCE.

More criticisms have been written concerning the bridge of the Trinity at Florence, Italy, than perhaps of any other of equal importance. There are three spans, the center one having a clear length of 95 feet 10 inches and the two side ones 87 feet 7 inches, with a rise of one-sixth the span. The piers, as can be seen from the view which shows one side span, are in reality abutments with the great thickness of 26 feet 3 inches and with prominent acute-angled starlings both up and down stream. The intrados is made up of two

parabolic curves, which meet at the center with a slight angle, which is concealed with a large escutcheon that extends up over the parapet as well. The piers are faced with cut stone, the moldings being very elegant. The arch ring is very heavily molded and the spandrels paneled. This method of detailing is not so inappropriate for spans of this length as it is for very large spans and the structure presents a very finished and elegant appearance.

The engineering is very good for the date of its construction, the year 1750, the design being that of Ammanati. Had the two piers been made of only ordinary thickness and abutments employed projecting out from the river walls, the proportions would have been much more pleasing. The parapet walls are of perfectly plain design except a slight molding under the coping, and pedestals at the ends which are surmounted by statues.

"F."

See Frontispiece.

THE PROPER CURBING OF STREETS.

MR. HORACE ANDREWS, the City Engineer of Albany, N. Y., has written an excellent paper on this subject for "City Government." The position that Mr. Andrews holds has given him a special fitness to write of street paving. For many years this was a branch of municipal administration that was wholly neglected in Albany. The streets were roughly paved with cobblestone, and even these were not kept in good repair. But finally the citizens of the ancient burgh were stirred up by the wretched condition of the streets, and now granite blocks or bricks are found on all the thoroughfares. The problem of curbing is particularly important in Albany, because the streets are so steep that the surface drainage is like a mountain torrent during a heavy rainfall. Mr. Andrews says: The methods of improving city streets have attained such a degree of development that further progress toward perfection must be necessarily slow, and can best be assured by a careful examination of each item entering into street construction.

We can realize the present excellence of modern streets by looking backward to the times, not so very remote, when the condition of the streets in London was far worse than anything we would now tolerate. At the close of the reign of Charles the Second, about 1685, when London was a city of about 500,000 inhabitants, its streets were in a state thus graphically described by a distinguished historian:

"The pavement was detestable. * * * The drainage was so bad that in rainy weather the gutters soon became torrents. * * * This flood was profusely thrown to right and left by coaches and carts. To keep as far from the carriage road as possible was therefore the wish of every pedestrian. The mild and timid gave the wall; the bold and athletic took it."

The conditions depicted are sufficiently appalling, and we might anticipate that the rapid advance of civilization would soon lead to radical reform. *However, at a date* of eighty years later, so little progress had been made

that we find the state of London streets described as follows: "Foot passengers are protected by rows of posts at intervals of four or five feet. Flat paving stones are not in general use, and those that have been laid down are small and insecure. * * * The only pavement both for the road and the footway consisted of large, round pebbles, over which the rolling of the vehicles made the most dreadful noise. In the year 1762, however, an improvement was introduced in Westminster, followed by the city of London in 1766.

"The roads were paved with squares of Scotch granite laid in gravel; the posts were removed; a curb was laid down, gutters provided, and the footway paved with flat stones."

Here we see the beginning of our present raised sidewalks, and can realize the painful inconvenience, endured for so many years, on account of their absence.

To retain the sidewalk at its proper elevation and to help form the gutter, the curbstone was used. It is the purpose of the writer to call attention to this detail of street construction to which, frequently, little thought seems to be devoted.

The functions of a curbstone are such that great stability should be insured, yet we often perceive that both permanence and strength are disregarded. Frequently specifications for pavement of the roadway call for excellent and expensive work, while the curbstone is either left to be furnished without extra cost, as an incidental, or a stone of most insufficient size is specified. A recent specification for sheet asphalt pavement in the streets of one of our large cities calls for a curbstone three inches thick, in lengths of four feet or over, and of such depth as to extend four inches below the surface of the pavement at the gutter, no special foundation being mentioned.

Let us consider the disturbing forces that tend to displace the curb and destroy its alignment. The pressure of the earth behind the curb, frequently augmented by heavy surcharges from piles of merchandise on the sidewalk, tends to overturn it. This pressure also tends to break the curb transversely or to cause it to slide bodily on its base. In our northern cities the most severe disturbing action is due to the freezing of the ground beneath the sidewalk. The pressure from the expansion of freezing earth behind the curb is most apt to occur where the sidewalk is partly sodded and the ground is accordingly moist. Successive freezings of the earth behind the curb will occasion a succession of thrusts forward till the curbstone, when of faulty design, is sometimes inclined 60° or more from the vertical.

The ground below the curb is also upheaved by frost at places where the sub-soil can become saturated through percolations from the sidewalks or permeable pavements on the roadway. The displacement from beneath tends to alter the height of the curb and to impair its appearance seriously. It is of importance that the height of the curb should be permanently maintained, as it serves for the regulation of the cross section of the roadway and sidewalks and for fixing the elevations of the houses. Where the sidewalks are sodded, and especially where the curb is of small cross section and improperly supported, tile drainage may be of benefit; the writer has found it possible to secure stability without such drainage, even with sodded walks. Drainage may

sometimes be a desirable safeguard, but great care should be exercised lest the soil should be so loosened in constructing the drain as to cause the curb to drop out of alignment. Posts and trees set too near the curbs tend to break and destroy the latter. Fires built in the gutters will deface and will seriously damage granite curb. The constant blows from wheels in narrow business streets will slowly destroy even the most substantial stone. To withstand the destructive impact of wheels curbs are faced with iron at certain places in the streets of London, and a concrete curb with a rounded edge of steel has been patented and used to some extent in this country.

The municipal engineer must seek a means of guarding against the destructive action of the various agents referred to, and at the same time he should endeavor to avoid an expenditure so great as to be oppressive. Where stone can be readily procured the writer believes this to be the best material for the visible portion of the curbstone, and that the best kind of stone is granite of good quality. To render such curbing economical it should have a cross section of moderate size; to insure its stability it should be reinforced with concrete. For æsthetic considerations the stone should be sufficiently well dressed to present a neat and uniform face and top surface. Granite has the advantage over most stone of looking well, even if somewhat roughly faced.

The comparative cheapness of concrete should lead to its liberal use, and in case stone is difficult to procure the entire curb may be formed of concrete. Such curb will never convey as good an impression as when formed of natural stone, nor will it resist the wear of vehicles as well. Concrete curbing must be made with extreme care, and with the best materials, but concrete used merely for adding to the stability of a stone curb need not be of better quality than that employed for the pavement foundation.

The curbstone should have a thickness at least equal to the depth of the gutter in order not only to be stable, but to appear so. In many cities abroad curbstone of as great a thickness as 12 inches is employed, and in Washington curbstones 8 inches thick and 8 inches deep are used. The occasional use of gutters of a depth of 8 inches or greater, especially at receiving basins, might render a depth as small as 8 inches insufficient. The writer is opposed to the use of a gutter stone. It is generally an unnecessary expense, and the longitudinal joint between it and the pavement is much to be condemned. In narrow and heavily traveled streets, every longitudinal joint having a length as great as one or two feet is sure to become a rut under the wheel traffic.

A concrete curb, with gutter formed in one piece, is admirably adapted to secure stability, but is open to objection for the reasons stated. The end-joints of curbstones should be so cut as to look well from the top and front. They should be substantially square, but need not be cut precisely so for the entire thickness of the stone. In Liege, in Belgium, the curbstones, $7\frac{1}{2}$ inches in width, are tongued and grooved at the ends, and a similar construction is seen in front of the Public Library in Boston. It is needless to say that such construction is merely an oddity, and is an unnecessary expense. The Liege curbstone is an interesting example of the development of one detail of street construction with the neglect of others of greater importance; for in that city, *the sidewalks, like* the roadway, are paved with cubes of stone $4\frac{1}{2}$ inches on a

side, concerning which a writer pathetically remarks: "One could wish himself shod in iron to escape the discomfort and pain caused by the inequality of these torturing cubes."

In setting the curbs it is well to keep the ends from actual contact; for this purpose strips of hoop-iron can be temporarily inserted between the ends of the curbs as they are set.

Specimen curbs should be placed on exhibition and referred to in the specifications. The pattern curbs should be dressed in every respect in accordance with what the engineer desires, and with due regard for what is practically attainable without excessive cost.

The foundation of the curb should be of concrete, having a depth of 6 inches. The depth of the curb should be such that the concrete under it will be nearly continuous with that under the street pavement.

The concrete placed behind the curb should have a thickness of 6 inches, and should be brought to a level surface of about 3 or 4 inches below the surface of the sidewalk. The layer of concrete under the pavement will then pass beneath and up behind the curbstone, affording an excellent support at a moderate cost, a cubic yard of concrete making foundation and backing for about 30 feet of curb. Concrete should have a slight excess of mortar, and should be composed of hydraulic cement, sand and stone in small pieces. It will then be possible to consolidate it without disturbing the alignment of the curb. A mold should always be formed for the concrete. For that beneath the curb a piece of 6 by 6-inch timber, placed in front of the bed, answers very well, and can be removed when the concrete is set. Boards, 1 inch thick, and left permanently in place, can be used for shaping the back of the concrete. Where a street is to be repaved the old curb may often be used to advantage in place of boards for backing the concrete.

The lengths of the individual pieces of stone should not be less than $3\frac{1}{2}$ feet. Contractors usually furnish stones considerably longer than this, as the labor of dressing joints is thereby reduced.

The appearance of street corners is much helped and vehicle traffic is facilitated by the use of circular curb of large radius. The writer for several years used a radius of 5.73 feet, which gave a length of curve of a tenth of a foot for each degree of center angle. This radius has more recently been increased to 8 feet.

The numerous driveways crossing the sidewalks should have small, circular corners. For these a radius of about 2 feet is a convenient one. Where streets are not laid out on a rectangular system the angles which the curb lines make with one another should be carefully measured in advance, and in all cases the circular curb should be cut to the proper length to join the tangents neatly.

In the city of Albany, N. Y., an effort has been made for several years to improve the quality and to increase the stability of the curb. The resulting appearance of the streets has been a source of satisfaction to the property-holders as well as to the city engineer.

About forty-seven miles of curbstone have been laid with concrete foundation. None of this curb exceeds 15 inches in depth, yet its alingment is much better than that of the former 20-inch curb on sand foundation. The

first granite curb was laid, on concrete, in 1889. It was 5 inches thick and 12 inches deep, costing $1.25 per foot. The sub-soil was blue clay, yet the curb has kept its height and alignment very well. The thickness of the standard curb is now 6 inches, the depth remaining 12 inches. About 5¾ miles of the 5-inch granite curb have been laid, while thirty miles of the 6 by 12-inch granite curb are now in place.

The granite curb as quarried costs about 22 cents per lineal foot, delivered in Albany, coming by rail from Vermont and New Hampshire. Contractors have often laid it at prices too small to afford any profit, making up their loss on other items. Thus, in 1897, 9.16 miles of 6 by 12-inch granite curb were laid at an average price of 39 cents per lineal foot for straight curb and 47.7 cents for circular. This year 7.62 miles of the standard curb have been laid at an average price of 52.5 cents per foot for straight and 76.4 cents for circular. The above prices include concrete and all incidental work.

Under the laws of the State of New York all curbstones used by a municipality must be dressed within the limits of the State. Practically this requires all granite curb to be dressed within the city. The result in Albany has been a favorable one. The employment of citizens has met with popular approval. The opportunity of purchasing curb in its rough state is not confined to one or two quarries, whereas the number of quarries turning out dressed curb is very limited. The cost of the curb to the contractor has therefore been materially lessened since the passage of the law referred to.

In conclusion, the writer would urge that substantial and handsome curbstone be used on all well paved streets. Without such curbing the best pavement looks somewhat inferior, and may be compared to a poorly framed painting. Civic pride can only be aroused and municipal improvement can best be insured by special attention to those details that appeal most directly to the eye, and a proper curbstone is not an insignificant detail.

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PRACTICAL STONE-CUTTING.—XVI.

PLATE 15.—Plan Section, etc., of a circular wall end steps in a stoop, or an entrance to a doorway, the wall to be covered with coping in two pieces jointed as shown in the accompanying plan.

THE problem presented in this plate is very similar to that given in the two preceding. The plan curves are again taken quarter circles, but drawn with a radius of greater length than that made use of in Plates 13 and 14. This, of course, increases the length of the wall curves as well as that of the coping; the length of the latter being too great to admit of its being made in one piece as in the problem preceding this.

The problem now to be explained is one to which we may again apply the Tangent system—that is, the molds may be developed by means of the system as taught by the teachers of the Tangent school. It is our intention to give in plates to follow later, several examples in which, owing to the conditions laid down in the plan, and the desired height of the rail above the string piece, the system in question cannot be applied or made use of in order to develop the several molds, etc., required to form the stones. Hence the advisability of having a system which not only saves material over that of the other, but which may be adapted to any condition or problem which may be met with in practical handrailing.

In this and the five following plates, we purpose explaining the method by means of which the face molds may be developed as required in order to form the ashlar of the well, together with an explanation of the two methods (the Tangent and Prismoidal), by means of which the pieces of coping may be formed.

In Fig. 1 O shows the center with which the plan curves may be drawn. The concave and convex face lines of the coping are shown respectively in R-U-Y and J-M-Q. The face lines of the wall are shown in i-l-q, the concave; and i-4-h, the convex. The tangents to the points A-C-E at which joints are desired are given in A-B-C, etc. The plans of the steps Nos. 1-8 are shown in 1-1′-2′-2, etc. The treads and rise of these are taken respectively as 12½ and 6¼ inches.

At the lower portion of Fig. 3 is shown the section at the center line of the stoop; the steps are shown in Nos. 1 to 8. For simplicity the risers are taken as plane surfaces. They may, however, contain, any form of molded contour without in any manner affecting the developments, as in all cases it is the riser lines as given in the plan, which are made use of in the developed

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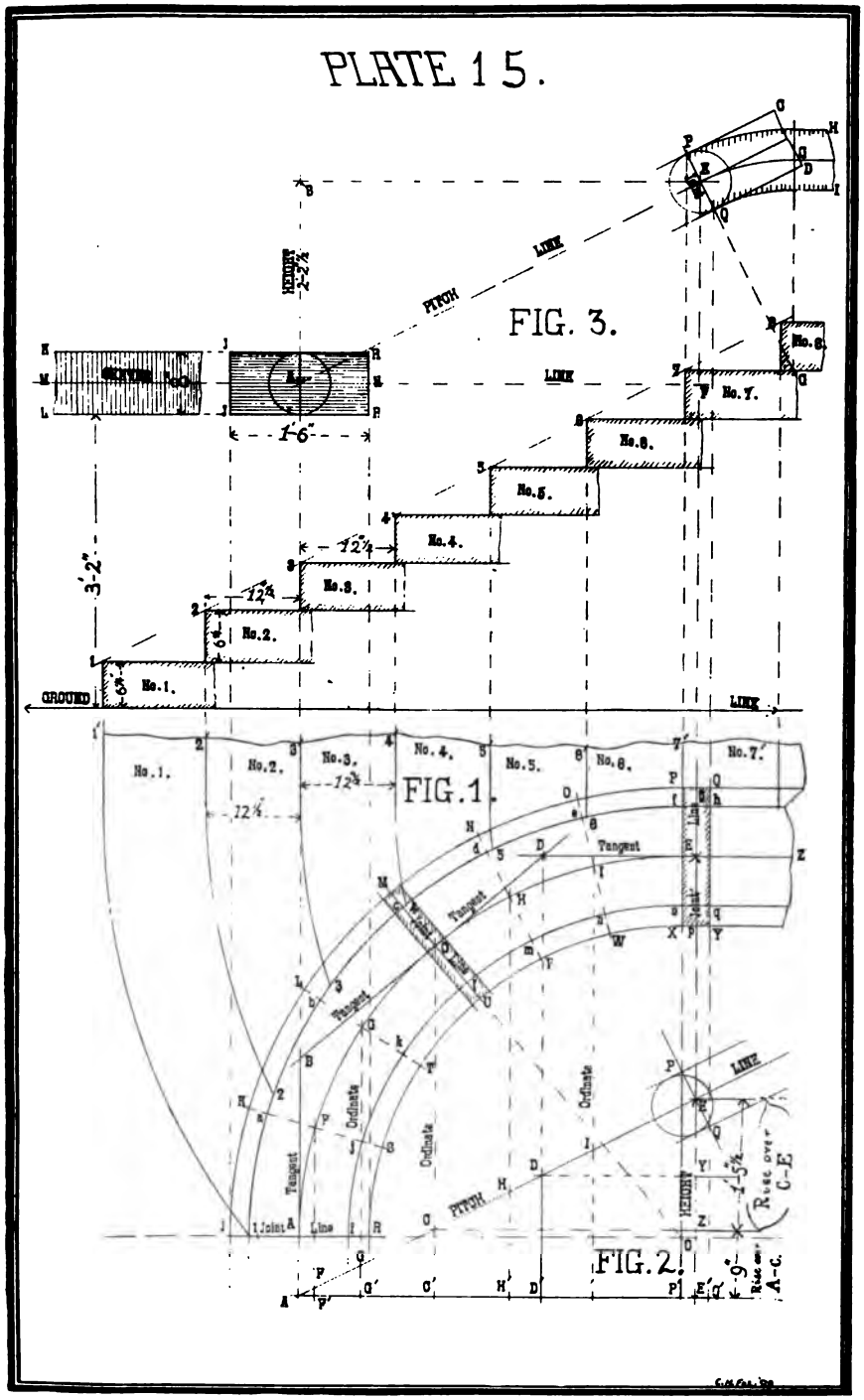
PLATE 15.
FIG. 3.
FIG. 1.
FIG. 2.
No. 1.
No. 2.
No. 3.
No. 4.
No. 5.
No. 6.
No. 7.
No. 8.
GROUND
LINE
PITCH
HEIGHT
Tangent
Ordinate
Joint
Line
Rise over A-C.
Rise over C-E.

drawings, the molded contour of the steps being added after the projections may have been made.

We have again taken the pitch line A-E of Figs. 2 and 3 as parallel with the nose line 1-8 of the steps, and that at the joint over A the coping joints up to a "level" coping, the top bed of which is at a height 3′-10″ above the ground line. The thickness of the coping is taken as 8 inches. The total rise of the coping is shown in A-B, and equals 2′-2½″—that is, the coping in going around the curved plan rises the height as given in A-B. This rise may be ascertained as follows: First, in Fig. 3 at the desired height above (in this case 3′-8″) and parallel with the ground line produce the center line M-F of the level coping. Then at right angles with the ground line from A-E of the plan, produce lines A-A, E-E, as shown. Then from A of Fig. 3 parallel with the noseline 1-8 of the steps, draw A-E. This gives the pitch line of the coping, and the height of E above F gives the rise of the coping.

In Figs. 1-2 is shown the method by means of which the rise of the coping may be ascertained over any portion of the plan. That of the lower piece of coping is given in E′-Z; that of the upper piece in Z-E. The method has already been explained in a preceding chapter so that a repetition is unnecessary.

It may be noted that the length of the curve A-C of the plan is greater than that of C-E. The reason of this is that had the center curve been divided into equal parts, the coping would be of unequal lengths—that is, the length of the upper piece would be much greater than that of the lower piece. The object should be to have the coping in two places of equal length. This may be attained if the center falling line be developed and divided into two equal parts; or, as the case may be, into as many equal parts as there may be pieces of coping in the wall. Then, transferring to the plan as at A-C, C-E, the lengths of the developments thus obtained, the coping may be jointed in pieces of equal length in the wall.

We explained in a preceding chapter "the coping at the upper joint surface may meet either a ramp or an inclined piece." What is meant may be seen in P-C-D-Q of Fig. 3, which is an elevation of the "inclined piece," while in P-Q-H-I is shown the elevation of a "ramp piece," the curves of which are drawn with center G. In a problem such as the one here presented, a "ramp" is the means generally employed for connecting at the upper joint surface the "twisted" with a "level" piece of coping.

C. H. Fox.

ANCIENT AND MODERN BUILDING IN PALESTINE.

AT a meeting of the English Architectural Association in January, Mr. Beresford Pite gave an illustrated lecture on this subject. Mr. Pite declared that it would be impossible for him to cover the subject with any thoroughness in one lecture, and he could only relate what struck him most forcibly when he visited Palestine. The lecturer then showed how the architectural interests of Palestine began with caves and rock tombs, cisterns and oil and wine presses, and then the buildings. The variety of influences which passed over the land in its early history had its effect on the people and their work. Beginning with Egyptian influence, they came to periods when Phœnician, Assyrian, Græco-Roman and Roman styles could be traced. Then the history of the country became obscure as they passed through dark ages to the Arab period. The years of crusading followed, dotting Palestine with interesting examples of Mediæval art. Turkish sway, too, had left its memorials, and as landmarks of modern work and travel some buildings presented the strong characteristics of the Gothic Revival. Apart from the artistic and historic periods there was the material to be considered. The building material most ready to hand was a hard limestone, difficult to work and offering little opportunity for ornamentation. The soil of the land was poor and yielded but scanty crops of coarse grain, so that when seeking to copy from nature the native imitated the heaviness of his surroundings. The country was also the seat of endless wars and disasters, so that durability and not beauty was the great aim of those engaged in architecture. The lecturer then gave some practical hints to those who might have to design for buildings in Palestine. The consideration of aspect was most important. It was always well to avoid an eastern aspect, and near Jerusalem itself it was advisable to turn the building away from the road because of the quantity of dust, which was terrible during the hot months when there was a drought of water. There were only two wells in Jerusalem, and the city was wholly dependent on the rainfall for its supply of water. In the absence, therefore, of a water supply the cost of water had to be seriously considered. If water ran out during building operations it meant an increase in the cost of construction. It was, therefore, necessary to begin building operations by constructing and excavating a cistern for the season's rainfall, thus providing against the drought which would certainly arise during the hottest months. There was an absence of any system of drainage, and no kind of cesspit could be properly adopted because of the hardness of the rock and the small depth of earth which covered it.

When designing a building the arrangements for heating had hardly to be considered. Fireplaces resembling those of the Western nations were not generally used. In buildings established for the protection of Russian subjects *Mr. Pite* said he noticed more attention had been paid to the heating of

the building, and stoves had often been adopted. The carriage of materials was a most important item when doing work in the East. The railway could only carry coal, so that it was impossible to send up heavy material in large quantities. Camels were the beasts of burden. In order that foreigners might erect a building of any size a royal firman from Constantinople was necessary, and even when this Imperial permission had been obtained the local authorities had to be pacified and a liberal amount of backshish expended before operations could be commenced. If mosques were in the vicinity of the site the permission was more difficult to obtain, the religious traditions and superstitions of the case bearing an important part in the negotiations. There seemed to be no builder, and consequently no contractor, in Jerusalem; but still the lecturer, with the assistance of a German architect resident in Jerusalem, had overcome such difficulties. Plans made in London had been carried out with the utmost accuracy. The workmen would only recognize one master, and thus the man who gave the orders must also have the paying of the men engaged on the job. There was an entire absence of sand for building purposes, but a good supply of lime was to be obtained.

Mr. Pite then gave a list of the prices charged for work in Jerusalem:

Roofing.—Tiles came from Marseilles and cost 25 francs per 1,000. The work was wired to battens; rewiring was necessary every ten years.

Bricks.—The best were foreign, the native ones were worth nothing. Bricks cost from 7 to 12 francs per 100 (*i. e.*, 4*l.* to 5*l.* per 1000).

Paving Tiles cost from 6 to 8 francs per square metre.

Timber.—About five times the cost paid at home.

Building cost for cubing about 12 francs per cubic metre, about 10 francs for foundations, and cisterns 10 francs.

Lime costs about one-twelfth of whole building; lime costs about one-fifth of cost of wall, including probably plastering; for girls' school (not plastered), one-seventh to one-eighth.

Walling.—Stones for inner side 1 piastre each, for outer side, hewn, 2 piastres each. Lime, 5 to 6 piastres. Wages and hauling, 10 piastres, or, in all, 12½ francs per square metre. Foundation walls, 10 to 11 francs, above ground, 14 to 16 francs; partition walls, 10 francs; dolma walls, *i. e.*, wooden framework filled with framing, 6 francs; vaulting, 8 francs—all per square metre.

Various Details.—Façade stone, 100 pieces, from 10 to 14 francs. External pointing, ½ franc per square metre. Corner stones or quoins, 2 francs each. Lintels and cornices, 3 francs per lineal metre, or 40 francs per door and window opening. Plastering, 1½ to 2 francs per square metre. Cementing new cisterns, 3½ to 4 francs. Plastering ceiling, 2½ francs. Tile roofs, including wood, labor, nails, etc., 12 francs; with heavier woodwork, 15 francs. Carpentry for window, glazed, painted and fixed, 50 francs. Per internal door complete, 50 francs; per pair of shutters complete, 40 francs. Iron bars fixed, ½ franc per kilo. Girls' school, Jerusalem, including boundary wall, gate-house and cistern, and clearing site, about 12 francs per cubic metre. Not plastered.

In the discussion that followed the lecture, Mr. A. C. Dickie said: The more modern Jerusalem had really few attractive features as regarded the

construction of buildings. New settlements were springing up outside the walls of the old city, and German shops were being opened. One of these settlements or villages had become famous, inasmuch as old and empty petroleum tins had been largely employed in its construction. The Kaiser's visit to the Holy Land would long be remembered by those interested in the antiquities and beauties of Palestine. Prior to the Kaiser's visit to Jerusalem, when the authorities were trying to improve the look of streets, etc., several acts of vandalism were committed. Although the streets were then said to present a cleanly appearance, it was hardly true, as the refuse and dirt of the principal streets were merely swept into the smaller and less frequented ones. Where old gilt-work in mosques had become dull, a little yellow paint was used to restore (such was the taste of the Turk) its first charm.

THE CALYX CORE DRILL.

ACCORDING to the report made by Prof. Boyd Dawkins in December last on the borings for coal at Ropersole, in Kent, England, which have been in progress ever since 1897, the result of the undertaking should soon be known, says the "Colliery Guardian," of London. At that time they had penetrated to a depth of over 1,400 feet, and "the question of the thickness of the strata which intervene between the bottom of the borehole and the ridge of coal measures and pre-coal measure rocks, can only be answered by the experience at Dover, coupled with the general thinning-off of the oolites to the north. At Dover they are 159 feet thick. Here they are probably thinner." The borings, which have been carried out with the Davis calyx drill, have now reached the depth of 1,530 feet.

It is interesting to note that through the whole boring of between 1,300 and 1,400 feet it was found necessary only to reduce the diameter of the boring from 9 to 8 inches, while the whole depth mentioned was carried down absolutely perpendicularly, confirming the assertion of the patentee that it was impossible to make a crooked bore when using the calyx drill.

The Davis calyx drill, while designedly for use in prospecting for coal, ores, etc., has special features that recommend it for light work in stone, slate and marble quarries, and in the division of large blocks that have been taken out by the blast or the plug and feather process. For such interest as it may have in these respects to our readers, we feel warranted in describing it herewith. It is described as an ingenious application of the principle of the *stonemason's* chisel to a rotary drill, a chipping action being exerted by the

hardened steel teeth which form the cutting edge of the bit. In the use of the ordinary form of drill the whole of the rock embraced by the area of the well has to be sufficiently broken up to admit of its being removed by the sand pump; the calyx drill, on the other hand, results in the cutting only of an

FIG. 1.—DRILL AT ROPERSOLE FARM, KENT, WITH CORES OF CHALK AND FLINT 9 INCHES IN DIAMETER.

annular channel, and there is far less detritus to be extracted, it being chiefly in the form of core.

Some of the principal advantages which this drill seems to possess are as follows: The core produced by the cutter can be grabbed at will; when cut away from the parent rock the chips cannot be driven back into the crevices of the wall; the teeth of the drill, when subjected to great pressure, sink vertically into the rock; the slow rotary movement of the drill rods conserves the energy with which the cutter is worked; and no chips are ever washed over the surface.

One of the achievements of the calyx drill, during its employment, was the boring of 101 ft. in a 10-hour shift at the Ropersole farm, Kent, where the coal borings are proceeding at the present time. The result of this piece of work was the extraction of the 9 inch cores shown in illustration of the apparatus in Fig. 1. The value of this special drill has been proved in several other parts of the world, as is testified by the reports made upon it by Government officials. In the annual report of the Secretary of Mines of Victoria for 1894, it was stated that "the cost of boring has been considerably reduced since the use of the Davis calyx boring machine has been employed in this class of work." The work was the search for coal in different districts. Four bores were put down with this drill to a depth of about 2,334 feet, the average cost

of which came out at about 6s. 0½d. per foot. In the younger colony of Western Australia also, the calyx drill has been extensively employed, and, so far as reports are received, with very satisfactory results. In 1895, for instance, eight bores were put down with the drill to an aggregate depth of 4,574 feet, the cost of the work being substantially reduced compared with the use of other machines. In connection with the operations in Victoria in 1895 a 5¼-inch cutter was employed with other calyx connections attached to the ordinary drill-rod. One of the bores was cut at the rate of 3 feet per hour, another at the rate of 4 feet per hour; in another 8 feet were bored in one hour and forty minutes, or at the rate of 5 feet per hour. At an exhaustive trial which was made of this drill in connection with the exploitation of coal measures in the colony of Victoria the superintending officer stated that a reduction of 50 per cent. in cost was obtained, comparing this with the best drills being employed in the same localities. The Jeetho Valley Colliery Company in using one of the calyx drills, states with the bore running to a depth of nearly 800 feet, the cost of the boring amounted to 3s. 3d. per foot, and the total cost of the operation to 3s. 8d. per foot worked. In connection with the Jumbunna coalmining, during a fourteen months' exploitation, some five bores were put down, varying from 397 to 1,100 feet, the cost of the latter coming out at a trifle under 2s. per foot for the whole depth, inclusive of labor, erecting, removing and cost of fuel. The bores were 4 inches in diameter. The 3-inch core shown in Fig. 2 consists of compact sandstone, which was cut by hand power by the calyx drill, at a depth of 700 feet at Gippsland, Victoria. The illustration represents the actual size of the core raised.

So much this calyx drill has accomplished, and from a point of view of economy it is undoubtedly a great acquisition to the industrial world. In recent years so much depends on the economic saving which can be effected by new inventions—in fact, the success of any innovation may be said to rely almost wholly on the proportionate cost of the apparatus to the ultimate result in comparison with other and previous devices. Other things being equal, a saving in the ultimate cost of production is the deciding factor, and this saving the calyx drill appears to have effected.

As an auxiliary for prospecting for coal the calyx drill claims several advantages. It supplies the thickness of the seam to the eighth of an inch. It indicates also the "dip" and "rise" of the measures, which is, of course, an important item, while the disadvantages which have accompanied other drills of failing to preserve intact the core of coal has been overcome, and a complete core of coal is raised to the surface by the new drill. On the occasion of a visit of Mr. R. A. Townsend to the scene of the boring in Eltham, Kent, he states that "the tool was working in the gault stratum, a particularly fine soapy clay, which, with the percussion, would cause 'clogging' and 'caving.'" The calyx drill, however, "is capable of cutting the very soft as well as very hard rocks. It does its work rapidly, because it does not displace the material representing the whole area of the cross section of bore, cutting as it does only a small fraction of this area in the form of an annular ring less than an inch in gauge; the remaining portion of the area is represented by a core passing into a suitable core-barrel as the tool progresses downward. The drill is

rotated instead of a lift and drop, as in the percussion drills. The drill rods are hollow or tubular, and water is forced down these to the points of the cutting bit and answers the double purpose of keeping down the temperature of the steel cutters and of carrying upward the cuttings to the top of a receptacle, into which all *débris* lodges, at from 40 to 60 feet above the bottom of the bore as it progresses downward." The action of the tool being rotary, it

FIG. 2.—A 3-INCH CORE OF STRONG COMPACT SANDSTONE, CUT BY HAND-POWER AT A DEPTH OF 700 FEET.

is silent, and all jarring is avoided while at work. It is also fitted with an under-reamer, the use of which enables the operator to carry down iron casing *pari passu* with the descent of the drill, with the lower end of such casing so close to the cutting bit as to make caving impossible.

The construction of the under-reamer mentioned above is so arranged that it can be easily contracted or expanded at will by the operator. When lowered through the casing the teeth are allowed to expand; the top barrel of the under-reamer then falls into place, which locks the teeth in their required position. At the upper part of the under-reamer is a series of rings to suit the diameter of the chief cup, required to hold the cuttings, as well as to act as a guide to keep the borehole perfectly straight. The rotary motion is produced by means of the boring rods in the usual way, and a jet of water is thrown on to each tooth, which washes the *débris* into the chip cup, as when boring with an ordinary calyx cutter. The small number of working parts of which the reamer is composed enables it to be very easily kept in order. The teeth are easily sharpened, set and got into position. Where found advisable the boring and reaming can be carried on at one and the same time,

the under-reamer being attached to the boring rods directly above the chip cup.

The Davis bit or cutter consists of a cylindrical metallic shell, the lower end of which has been formed by a process of gulleting, into a series of long, sharp teeth, the design of which is quite novel. These teeth are set in and out alternately; those having outward set drill the hole just large enough to allow the apparatus freely to descend, yet not so large as to cause any deflection from the true line, the inwardly-set teeth dress down the core to such diameter as will admit the body of the cutter to pass over it without binding. The resharpening consists in merely dressing up the teeth on an anvil, like so many pick-points. The drill rods are connected to the core barrel, by means of a reducing plug, which also serves to close the lower end of the calyx. This latter is a long tube or series of connected tubes located above the core barrel, to which it is equal in diameter. It also encircles the lower drill rods between which and itself there is a considerable space; at the upper end it is kept concentric with the drill rods by means of a centering device.

Comment on Timely Topics

THE BUSINESS OUTLOOK

THE reports of the commercial agencies are to the effect that the business for the past month was by far the greatest ever known for February. Clearing House exchanges were about $7,000,000,000, against $5,567,553,844 last year, and 54.2 larger than in 1892. In all the years of weekly commercial reporting there has been no other week in which the reports from all parts of the country have been so good as the first week of March. Moreover, during the last week of February there was a general advance in wages immediate or prospective. Iron works at Pittsburg and in the Valleys set the pace which the Pennsylvania Steel Company, with 6,000 hands, and the Sparrow's Point Works, with 2,000, and the great tin plate combination with many establishments have followed. At most points an advance of 10 per cent. or more was entirely voluntary. It has averaged 5 to 10 per cent. in tin plate works, and about 10 per cent. in other cases, and as it affects much over 100,000 hands it will add greatly to the purchasing power of the wage earners.

The return of failures in February, while showing larger liabilities than in January, are highly encouraging. A rather unusual number of large failures in scattered branches of manufacture has swelled the aggregate, including one concern for $1,000,000 in electrical apparatus, but in nearly all branches the statement indicates a remarkably healthy condition in spite of these failures, while in trading the defaulted liabilities are smaller than in January or any previous winter month for six years past. Prices have also shown a marked advance, specially in iron and steel products.

Another indication of the general wave of prosperity has been found in the reports received by New York's State Factory Inspector from his deputies. During the months of December, January and February, 9,600 inspections were made by them, and of this number 373 were found to be new firms in business, and 100 were old firms who had resumed business after suspension. It was found that 1,119 firms had increased the number of their employees.

Naturally no industries are more sensitive to general financial conditions than the building and allied trades. It needs no seer, therefore, to predict

the general and lasting effects of this era of prosperity upon the stone and cement industries. That the period of depression that has been noted for the past few years will give place to healthier conditions, does not mean, necessarily, that prices will rapidly advance. Other influences are at work that have to be taken into account. A prominent stone dealer of Bloomington, Ind., says that the outlook for the stone business this year can be summed up in a few words: "There will be a greater volume of business, but prices will be lower." He added: "The larger quarries are responsible for this state of affairs, as they have been the ones that have cut prices. It is impossible for small quarries to make money under the existing conditions; but, notwithstanding, there will be a number of new ones opened in the spring."

Almost without exception, the staff correspondents of STONE in different parts of the country, report a flattering outlook in the general stone and cement industries. Quarries and works everywhere are preparing to handle a large increase of business during the coming months.

CAESAR'S FUNERAL PYRE AND THE TOMB OF ROMULUS.

FOREIGN correspondents have had startling stories to tell during the past few weeks about remarkable discoveries made in the Forum at Rome. According to these veracious writers there have been found nothing less than the site of Cæsar's funeral pyre and the black marble slab generally supposed to mark the spot whence Romulus—if historians will admit that the founder of Rome is more than a myth—was translated to the gods. It was on the first named spot, they declare, two days after the famous Ides of March, forty-four years before the Christian era, that the body of Cæsar was cremated. The fire burned for several days. Afterward a column of Numidian marble about 20 feet high was set up on the spot, and subsequently a small oval temple was raised around it. This pillar was afterward removed by Augustus. Its base has now been unearthed, together with a quantity of ashes and burnt stones, probably the actual remains of the fire which consumed the body of the great Roman. This base stands upon a mosaic pavement of great beauty. In Roman annals the "lapis niger" or black marble slab was always associated with Romulus and the she-wolf, said to have suckled him and his brother Remus.

So much for the newspaper correspondents. Now comes Mr. St. Clair Baddeley, an excellent authority, who makes this iconoclastic statement:

"It may be of use to suggest that statements made concerning both the most important recent discoveries in the Forum should be accepted with considerable caution. The octagonal pedestal of the column erected to Julius Cæsar, in the one case, is made of tufa concrete, a material not employed for such purposes until days very long after his date, while in the case of the so-*called 'Tomb of Romulus,'* in front of the 'Curia,' the material uncovered con-

sists of quadrangular blocks of 'nero venato,' or marble, from Cape Tænarus, sufficiently irregular in size as to suggest work of the third century A. D. They have, it is true, suffered by exposure in ancient times, and still more by the superposition of still later pavement of 'selce' or lava blocks, but they can never have been precisely uniform in size. They measure on an average 60 centimetres by 75 centimetres, and are 19 centimetres to 25 centimetres in depth. That some object of great historic importance will be found beneath we may rest assured, but whether it will prove to be related to Faustulus or to the story of Attus Navius and the Whetstone, none may yet say. As the whole of this portion of the Forum was swept by the fire of Carinus, the pavement probably dates at earliest from A. D. 260. It may originally have been square, it is now about 4 m. by 3 m. 7 cent.; orientation, S.E.-N.W."

It is well to remember that newspaper correspondents are responsible for many of the most remarkable "discoveries" of the century. They have shown what they can do in science and medicine, times without number, and great reputations have been almost ruined because subsequent achievements did not equal advance newspaper promises. If the correspondents invade the field of archeology, nothing but the limitations of their own imaginations can put a bound to their wonderful finds.

THE THREATENED STRIKE IN ENGLISH BUILDING TRADES.

AS this magazine goes to press there is a strong likelihood that the building trades of England, Scotland and Ireland will soon be brought to a standstill. Nothing can prevent such a condition of affairs unless the men in the Plasterers' Union repudiate the acts of the officials they have chosen. As in most of the recent big strikes in Great Britain, this is not a question of wages, but the employers make the claim that they cannot conduct their business properly under the restrictions imposed by the Union. A conference meeting was held at Bradford, and the Master Builders called upon the Plasterers' Union to abandon:

1. (*a*) The persistent attempt to coerce foremen of plasterers or superintendents of plasterers' work into the membership of the National Association of Operative Plasterers; also

(*b*) The threat to withdraw all members from the building firms employing such foremen or superintendents.

2. The limitation of apprentices.

3. (*a*) The practice of boycotting certain building firms and employers of plasterers in spite of the fact that such firms adhere to the rules agreed between the Master Builders' Association and the National Association of Operative Plasterers.

(*b*) The practice of printing and circulating among the members of the National Association of Operative Plasterers a list of such firms for whom they are forbidden under penalty to work.

4. The refusal to work on buildings where some of the workmen employed may not belong to a trades union.

5. (*a*) The refusal to accept the decision of the employer as to which

workmen shall do certain work, in cases where plasterers dispute with other trades as to their right to do such work.

(*b*) The practice of withdrawing all their members when such work may not be placed in the plasterers' hands.

6. The objection to submit all trade disputes to discussion at a conference between employers and employed, with a view to arrive at an amicable settlement prior to any strike or withdrawal of workmen.

The Union secretary answered that the limitation of apprentices is a purely local question, "each branch or district having power to make its own arrangements with the employers within its jurisdiction." He refuses to withdraw the black list of firms for which members of the Union must not work. The Union further claims to be equally qualified as an employer to be able to judge what is and what is not the work of a plasterer. The masters described this reply as "an evasion of all the points at issue," and warned the Union that unless an official and definite assurance was given that the objectionable practices would cease, a lockout would be declared at an early date. The plasterers asked time for further consideration, and proposed a ballot of their members on March 1. The Standing Committee of the employers met and held that "unless there existed a determination on the part of the Union to persist in the objectionable practices already specified there could be no reason why the required promise to discontinue them should not have been given at once," and the secretary was accordingly instructed to inform the Plasterers' Union that the National Association of Master Builders decided to declare a lockout against the Union to remain in force until the latter should guarantee the cessation of the said objectionable practices. The issue is thus joined.

Hitherto the plasterers have shown no desire to avoid a struggle. The members of the Union number at present about 13,000. Their income is about £14,000. The total balance of funds in hand was in 1897 (the last year reported on) £11,691. Thus the Union is not very strong. But the effects of a lockout would certainly be to throw other allied trades out of employment within a very short time. Besides, there is always the possibility of other unions taking up the quarrel and thereby helping to widen the area of the struggle. A big employer says that the Union will not allow its men to lay more than 400 bricks a day. The London County Council which, through its Works Committee, is a direct employer of labor and calls itself a model one, cannot get its bricklayers to lay more than 200 a day. The strength of the Union now lies in the fact that as it everywhere keeps down the number of apprentices the masters have only a limited supply of men in the country who have even the roughest notion of plastering, bricklaying or mason work.

Limes and Cements

Iowa lime manufacturers have organized for mutual protection, etc., and it is said that every manufacturer in the State is a member of the association. At a meeting held Feb. 14 at Maquoketa the organization was perfected and the following officers elected: President, L. B. Stewart, Monmouth; vice-president, Mr. Joiner, Maquoketa; treasurer, George Fengler, Dubuque; secretary, A. A. Hurst, Maquoketa.

Wesley Leckner, representing the New York Cement Co., is prospecting at Donald's Lake, Vandalia, Mich., where there are large deposits of marble. Leckner claims to have options on nearly all of the land surrounding the lake, and talks of the erection of a cement plant with a capacity of 1,000 barrels a day.

Detroit parties have gotten options on about 1,000 acres of land surrounding Four-Mile Lake, lying between Chelsea, Mich., and Dexter. It is claimed that extensive marble beds exist around the lake, and can be utilized for the manufacture of Portland cement.

Ground has been broken by the Illinois Steel Co., at South Chicago, for the construction of a monster plant for the manufacture of cement from pig iron slag.

W. W. Pierce, who brought suit against the Buffalo, N. Y., Cement Co., Limited, to compel the president of the company, Lewis J. Bennett, to give an accounting of his acts, has begun another suit to prevent the company from extending its corporate existence after the year 1901, when its charter expires.

The Central Freight Association, at its February meeting, in Chicago, decided to increase the minimum weight of carloads of lime to 30,000 pounds, effective at once.

The Gumbo Cement Co., of Chicago, has been incorporated. Capital stock, $6,000; incorporators, Frank S. Pagin, Alan H. Tripp, and Herbert V. Seymour.

S. J. Hirschmann, J. W. Sturtevant, Hon. I. T. Deyo and C. C. Jackson, of Binghamton, N. Y., and C. C. Pratt, of New Milford, have sold their interests in the Helderberg Cement Co., of Howe's Cave, to Albany capitalists, who held a majority of the stock.

Slacking lime in the storehouse of S. H. Hawes & Co., at Richmond, set fire to the building and did $50,000 worth of damage.

In the case of the City of Chicago vs. The Manhattan Cement Company, the law compelling cities and counties to pay damages in case of riot is held to be constitutional. In the railroad strike of 1884 $150 worth of cement was destroyed, and suit was brought to recover this amount. The point involved was the declaration that the law was unconstitutional on account of the fact that the law places a limit on indebtedness of cities, it being claimed that Chicago at the time was in debt to its full limit. This case was made a test, and was carried to the highest court. Other suits, involving as much as $5,000,000, will probably be instituted.

The Peerless Portland Cement Co., of Union City, Mich., has reorganized with the following officers: President, A. W. Wright; vice-president, S. A. Bush; secretary and treasurer, E. B. Kalb; manager and cashier, L. K. Forsythe. An extensive addition is being made to the works.

The case of Frederick Von Blucher against the Portland Cement and Lime Works of White Cliffs, Ark., has been decided in the District Court of Little River County, at Richmond, Ark. Von Blucher was awarded $10,000. At the incipiency of the cement and lime project at White Cliffs several years ago the management offered Von Blucher a half interest in the enterprise for his services as an expert assayist in locating sufficient deposits to justify the erection of a system of works. Von Blucher accepted and succeeded in the undertaking, which resulted in the present es-

tablishment. On settlement day the defendants receded from their proposition, which occasioned the suit.

The Western Lime and Cement Company, of Milwaukee, Wis., has purchased outright the plant, realty and business of the Hamilton Lime and Stone Company, and A. K. Hamilton. The new owner assumed charge of the Hamilton plant in Fond du Lac County, March 1. This purchase involves one of the most valuable lime plants in Wisconsin, and one which has been in active operation since 1883. The deal includes the purchase of the real estate of the Hamilton Company, consisting of 178 acres, the tenement houses occupied by workmen, about fifteen buildings in all, and the stone and lime plant. The annual output of the Hamilton quarries has averaged 150,000 barrels of lime, and 10,000 cubic feet of crushed stone, besides large quantities of flag curbing and building stone, which have been shipped to all parts of the State, the West and Northwest. The officers of the Western Lime and Cement Company, the new owner, are: President, O. W. Robertson; vice-president, A. T. Howe; secretary, R. C. Brown; treasurer, Charles Weiler.

The Owosso Artificial Stone and Paving Co., of Owosso, Mich., has filed articles of association at Lansing.

Andrew Carty, half owner of the Knickerbocker Lime Company, of East Whiteland, Pa., is dead at the age of seventy years.

The Omega Portland Cement Co., of Jonesville, Mich., has been incorporated, with a capital of $300,000. The directors are A. J. Jordan, of Jackson; F. M. Stewart, and W. H. Sawyer, of Hillsdale; Israel Wickes, of Jonesville, and F. A. Roethlisberger, of Allen.

The Western Plaster Works, of Alabaster, Mich., has changed its name to the Alabaster Company.

The Findlay, Fort Wayne and Western Railroad is preparing to start a stone-crushing, lime and cement plant at Findlay, O., employing from 200 to 300 men.

The Adamant Plaster Company, which recently went into the hands of a receiver, has resumed work in both the Syracuse, N. Y., and Hastings mills.

George W. Johnston, of New Castle, Pa., and others, representing the Pennsylvania Limestone Company, have purchased the Grist & Graham limestone quarry situated at Lowellville, O. The offices will be located in New Castle.

Messrs. Lilley and Beatty will resume the manufacture of lime at Rocky Ridge, Ohio.

The Beaver Portland Cement Company, with a capital of $150,000, has been incorporated to manufacture a high grade of Portland cement at Dry Lake, near Marlbank, Ont. The president of the company is Mr. James Dobson, the carpet manufacturer, of Philadelphia and New York. The manager of the works, which will turn out 600 barrels a day, is William G. Hartranft, of Philadelphia, a veteran cement maker.

C. L. Deal, of Gainesville, Ga., will purchase equipment for a cement factory.

"Stone" Made from Glass.

A report has been made to the Central Architectural Society of France concerning the products of the Ceramo-Crystal Manufacturing Company, of Lyons, France, which is manufacturing paving blocks, building blocks, etc., of a new material. The report says:

"From the various forms in which this material is presented, its use can be readily determined for both practical and decorative purposes. On careful examination it is found that the Garchey ceramic stone is nothing but glass brought to a special molecular condition. In a certain sense it constitutes a new substance which resembled flagstone, granite, or marble. The manufacturer assures us that with this material he can copy any model that is presented.

This new product is obtained from broken glass heated to a temperature of 1,250° C., and compressed in matrices by hydraulic force. The physical transformation of glass is due to devitrification under the Garchey process. The phenomenon of devitrification produces a sort of dissolution more apparent than real; for, upon chemical analysis, the devitrified glass preserves the identical composition of natural glass. It may be said, then, that devitrified glass possesses all the intrinsic qualities (physical and chemical) of glass, except the transparency, while taking on an entirely different aspect. Furthermore, glass treated under this new method is made to resist crushing, frost and heavy shocks and to stand usage."

The Slate Trade

The Wind Gap, Pa., Slate Manufacturing Company are considering a proposition made to them by local parties to lease and operate their quarries.

The quarry of the Bangor, Pa., Slate Company is in the hands of the sheriff to satisfy a judgment issued to trustees for the bondholders.

The Slate Belt Telephone Company is rebuilding its line and has put in a metallic circuit from Easton to Pen Argyl.

At the present time pencils are being made in Tennessee from slate dust and other ingredients molded under hydraulic pressure according to a patent formula. These pencils are free from grit, and do not scratch like those that are cut from solid slate, and which are imported, chiefly from Germany. Efforts have been made periodically in America to establish a "solid cut" slate pencil industry, more particularly in Vermont and Virginia, but without success, owing to the cheapness of the imported article. However, the manufacture of pencils from slate dust is steadily increasing. One large concern in Chattanooga, Tenn., informs us that its output in 1898 aggregated 25,000,000 pencils, as against 13,000,000 in 1897. These pencils are shipped to almost every civilized country in the world.

Tramp steamships are to be chartered for the slate export trade by the American Slate Mart & Wharf Company.

The London "Quarry" says: Mr. J. E. Nelson, of the Borough Road Slate Works, Sunderland, at a dinner given by him to his workmen, stated that he intends converting his business into a profit-sharing concern. Personally, he believes the solution of the labor problem lies along the lines of a copartnership between capital and labor, and he has come to the conclusion that he would like to conduct his business on a profit-sharing principle—a kind of limited copartnership. He proposes that from to-day his workmen should found the new arrangement. At the close of the year they would total up the profits, and after allowing 5 per cent. for capital, he proposes to distribute 15 per cent. of the remaining profit among the workmen. He has told them what he wants them to do in return. There were thousands of bags of slate and other materials that went out of the yard every year, and much was thrown away through the men not caring to bring back odds and ends after finishing a job. When they remembered that many a mickle made a muckle, they would see that that would total up to a lot in a twelvemonth. He appealed to them to attend to those apparently small matters. To make the scheme a success each workman would have to do his work as though he was looking after his own interests. By so doing they would get through more work, and would share more profits.

Captain David Jones, for over fifty years heavily interested in the development of the slate industry at Delta, Pa., is dead.

A slaters' union has been formed in Pennsylvania with the following provisional officers: President, William Harding, Jr., Pen Argyl; secretary, John Youlton, East Bangor; treasurer, James Cowling, Bangor. A general executive board consisting of six members was also elected.

Thomas Masters, Jr., and W. J. Masters have bought out the interest of their brothers, John and A. W. Masters, in the Excelsior quarry.

James Masters, of East Bangor, has purchased the interest of E. D. Peters & Co., of Slatington, in the Bangor Southern quarry, near Delabole. Mr. Masters now has control of the entire business of operating the quarry.

The strike at the Bangor Excelsior quarry has ended and the men returned to work at the old wages.

J. B. Kellow, Samuel Cann and Quintus Sandt have taken a lease of the Blair prop-

erty, adjoining the old Diamond quarry at Pen Argyl.

At the annual meeting of the East Bangor Consolidated Slate Company, the following directors were elected: S. C. Smith, of Phillipsburg; George R. Givens and Henry Green, of Easton; Judge George M. Shipman, of Belvidere; John P. Wood and S. S. Wood, of Philadelphia; William D. Kern, of Martin's Creek; Henry Short, Jr., and William Bray, of East Bangor. The board organized by electing the following officers: President, S. C. Smith; vice-president, John P. Wood; manager, William Bray; secretary, B. W. Ribble.

T. A. H. Hay, of Easton, a director of the Easton, Palmer & Bethlehem Electric Railway; C. C. Richardson and M. P. McGrath, of the Worcester Construction Company, of Worcester, Mass., and N. D. Chase, of Easton, are considering the feasibility of building an electric railway from Wind Gap to East Bangor. At each of the towns through which the proposed road would pass they have conferred with business men and others to learn the sentiment of the people in regard to such a road and to see what encouragement, if any, would be given such a project. The gentlemen were very cordially received everywhere, and were favorably impressed with the slate belt as a good territory for an electric road. They expressed the opinion that they would build the road.

During the month of January there were 138 carloads of slate shipped from the Pen Argyl quarries, as compared with 102 carloads in January, 1898. The weather in February interfered materially with the shipping of roofing slate. From Slatington there were sent out about 7,900 squares, as compared with 12,433 squares in January, and 6,473 squares in December. Walnutport shipped in February 80 squares, as against 573 squares in January, and 295 squares in the previous month. Danielsville reports having shipped 1,485 squares in February, against 2,244 squares in January and 2,537 squares in December. The shipments of school slates through Slatington in February were five times as large as those made in January, but a decrease is noted in blackboards. Walnutport reports that it handled about one-quarter the quantity of blackboards in February that it did in the previous month. On the *other hand,* Danielsville showed a movement of 172 crates blackboards, against 147 crates in January, and 488 crates in December. It also reports shipments in February of 607 crates flagging, as against 125 crates and 183 pieces in January, and 402 crates and 340 pieces in December.

A Newly Discovered California Marble Deposit.

Rich deposits of building marble have recently been located near Healdsburg, Cal. A writer in the "Pacific Builder," of San Francisco, says:

But very few persons probably have yet learned that some beautiful deposits of marble have recently been discovered at the very doors, so to speak, of this city. Sonoma county, for it is in old Sonoma that these deposits have been located, stands ready to furnish to San Francisco all the marbles it can use for fifty years or more. This may appear to be a broad statement to make, but the time is approaching, just as sure as the sun rises and sets, when those engaged in the art and practice of building on this coast, will wonder how it could possibly be that for so long a time they have been paying for transporting marble thousands of miles to San Francisco, while right at the very edge of the city, we may say, we have an abundance of marbles as good and as beautiful in every respect as any in the world. * * *

The editor of the "Pacific Builder" has recently visited the newly discovered marble deposits referred to, and while as yet but little development has been done, the indications from the surface, and from the general contour of the ground, certainly points to the existence of extensive deposits, and it is claimed that solid blocks up to twenty tons each can be obtained. The colors are brown, light and dark, light red blending into pink, also cream in various shades. The veining of one piece, which stands before us as we write, is, we consider, fully equal if not superior to the red Tennessee, and in shades for wainscot work would be very attractive. The variety of shades are such as would enable an architect to produce compositions in color at once new and effective, while the character of the rock is such that it can be sawn, coped, carved and polished as easily as any other marble.

Marble and Granite

The lowest bidders for the construction of the building for the new naval academy at Annapolis, Md., were Carlin & Co., of New York, and this company's bid was accompanied by specifications that the granite should come from Booth Bros. and Hurricane Granite Co.'s quarries, either at Waldoboro or Long Cove, St. George.

Cincinnati capitalists are prospecting about Knoxville, Tenn., with a view of starting a new marble mill.

The Sibley Quarry Co., of Michigan, has just sent 300 tons of limestone to the United Alkali Co., of Widnes, Eng., who will test it in making plate glass.

Mr. Tobias Hermann has purchased the Macomb, Ill., Marble & Granite works.

The Culver Stone Company, of Springfield, Ill., has changed its name to the Culver Construction Company.

The granite cutters of Quincy, Mass., struck March 1. They demanded a minimum price of 30 cents an hour, and the employers offered 25 cents. The strike affects 91 firms and about 1,200 cutters.

The Amilcolola Marble and Power Company, of Pickens county, Ga., has recorded an issue of $200,000 worth of bonds, dated Sept. 1, 1898, and payable Sept. 1, 1918.

The Brewster Granite Co., of New York City, has been incorporated, with a capital of $50,000. Directors, C. E. Gregory, J. H. Weinberger, A. L. Schaeffer, S. B. Whiteside and W. G. Brown, of New York City.

Mrs. R. M. Oursler has opened a marble and granite works, at Carnegie, Pa. Mrs. Oursler is probably the only woman in the State engaged in a similar agency. Her husband was in the business and on his death two years ago she assumed the general management.

A law is being pushed in Minnesota requiring all public buildings in that State to be constructed of stone, quarried, cut and dressed in Minnesota.

The Avondale, Pa., Marble Company has been reorganized under the name of the Pennsylvania Marble and Granite Co., and the name of the postoffice has been changed to Westgrove.

The Stonecutters' Union, of Joliet, Ill., has given notice that after April 1, eight hours shall constitute a day's work, and that the wages shall be 37½ cents per hour.

The Stonecutters' Union, of New Orleans, is working for an eight-hour day.

Indiana is about to erect a monument on the scene of the Pigeon Roost massacre, in Scott county, where in 1812 twenty-four people were killed and scalped by Indians. A monument is also advocated for the battle of Tippecanoe.

A marble company at Columbia, Mo., erected an immense granite shaft, weighing 47,000 pounds, over a grave in the cemetery there.

Durant D. Bulman, a marble dealer, of Baltimore, is dead, aged 53 years.

The Binghamton, N. Y., Stonecutters' Union has asked Senator Platt to vote for the eight-hour bill now before Congress.

F. L. Fisher has been appointed receiver of the East Tennessee Stone and Marble Company, at the request of stockholders.

The Marathon Granite Co., of Wausau, Wis., has been incorporated, with a capital of $100,000. The officers are: President, Walter Alexander; vice-president and treasurer, R. E. Parcher; secretary, C. B. Bird; directors, R. E. Parcher, Walter Alexander, David Flinn, Fred DeVoe and C. B. Bird.

Robert M. Boyd, Jr., has been appointed ancillary receiver of the J. L. Murray Marble Company, a New Jersey organization doing business at 541 West 22d street, New York.

The Jerseyville, Ill., Granite and Marble works has been incorporated by Wm. H. Houghtelin, George H. Van Horne and Robert L. Hall.

Andrew Roegner & Co., is a new granite and marble firm at Watertown, Wis.

The Plock and Murray Company has been incorporated, to deal in marble and other stones in New York City.

Ex-Mayor Job N. Congdon, of Binghamton, N. Y., formerly in the marble and granite business in that city, is dead, aged 78 years.

The Bridgeport, Conn., Steam Stone Company has been incorporated. It will turn out monumental and building material.

The committees of the Granite Cutters' Union and the Manufacturers' Association have met in conclave at Barre. Concessions were made on both sides and it was agreed to advance the price of wages from 29½ cents to 30 cents per hour. The demand was for 32 cents per hour. It was agreed that the number of working hours were to remain the same as last year. Under the present arrangements the cutters stop work if payment for wages is not forthcoming on the fifth day of each month.

The Albertson Marble Company, of Rutland, Vt., has petitioned the Supreme Court for a dissolution of the company.

Calvin S. Davis, of Niantic, has been re-elected president of the Granite Manufacturers' Association, of Connecticut.

A bill has been introduced in the Montana Legislature appropriating additional money for the State capitol, so that granite may be used instead of sandstone in the construction.

O. H. Gilbertson has purchased the interest of his partner, John Richards, in the Spring Valley, Minn., Marble works.

John Strait and F. E. Woodard have formed a partnership in the general marble business at Rock Rapids, Ia.

Edwin Forrest will open a marble and granite works at Wabash, Ind.

Charles H. Moore, of Montpelier, Vt.; George C. Preston and William C. Preston, of Kingston, N. Y.; Hamilton McWhorter and Frank R. Smith, of Oglethorpe, Ga., have incorporated the Southern Westerly Granite Company, of Georgia, with a capital stock of $100,000.

A receiver has been appointed for the firm of Heys & Muste, dealers in marble and granite, at Grand Rapids, Mich.

Byrne Bros.' Marble works, at St. Charles, Minn., have been destroyed by *fire.*

A steam plant has been installed at the serpentine marble quarries on Catalina Island, Cal.

The Mantorville, Minn., quarries have put in one of the largest steam derricks in the State.

Georgia marble will be used in building the State houses of Rhode Island and Minnesota.

Hanford R. Nash, of Brooklyn, formerly of the Alberene Stone Company, of New York, is dead at the age of 67 years.

A. P. Watson, of the marble and granite firm of Stinson & Watson, Starkville, Miss., is a candidate for railroad commissioner in his district.

The trouble between the granite manufacturers of Barre, Vt., and their employees has been temporarily adjusted, pending a final settlement by arbitration.

The St. Lawrence Marble Company, at Gouverneur, N. Y., has started up its quarries after being idle for three years.

The marble firm of Wilson, Strachan & Brewer, of Utica, N. Y., has been dissolved. Mr. Brewer will open a new shop, and Messrs. Wilson and Strachan will continue at the old stand.

The old York marble quarry, at Lee, Mass., is to be opened up again.

The business of E. P. Miller and H. D. Cash, at Hoopeston, Ill., has been purchased by Messrs. Charles T. Putnam and C. L. Chamberlin, and will be conducted under the name of the Hoopeston Marble and Granite Company.

Artificial Sandstone.

An artificial sandstone made at Uccle-Calevoet, Belgium, is a silicate of lime obtained by imitating the supposed conditions of nature. A mixture of 80 per cent. of clean, coarse sand and 20 per cent. of hydraulic quicklime is placed in an iron mold, which is introduced into a boiler filled with hot water, and is kept for three days under a pressure of six atmospheres and a temperature of about 329 degrees F. The resulting block is at first soft, but hardens quickly in air. The stone is absolutely homogeneous, absorbs little water, has four times the crushing strength of French freestone, and at the cost of ten cents per cubic foot is cheaper than the natural product.

Stone Trade Notes

The town of Mattoon, Ill., has decided to have stone instead of gravel roads.

The Bloomington (Ind.) "Courier" says: The stone men report that the indications are good for a big business. Much more is being done and a larger volume of business is being transacted than at any time since 1892 in the stone quarries. The order books are full and the prospects very flattering.

Woods & Co. have taken control of the Tumbleson stone quarries in Blue Creek township, Ind., and will at once install stone crushers.

The Hudson River Blue Stone Company, of Kingston, N. Y., has been incorporated, with a capital of $19,200. The directors are: Peter Boice, Curtis Ferguson, F. S. Rogers and H. L. Soap, Kingston, and James O. Beers, Saugerties.

By a boiler explosion at Frank Smaltz's stone quarry, at Myerstown, Pa., Monroe Billinger was instantly killed, and Irving Firestone and Frank Smaltz injured.

The Pittsburg Limestone Company, which conducts quarries at Franklin Forge and Tyrone Forges, Pa., has made a voluntary increase in its employees' wages of 10 per cent.

A despatch to the Hartford (Conn.) "Courant," from Portland, says: "The prospects of a revival of business in the brownstone quarries here is brighter than it has been for some time past. Both the Middlesex and the Brainerd, Shaler & Hall quarries began to-day working nine hours a day instead of eight, as they have been doing. A large force of men were hired in the Middlesex quarry yesterday. This looks encouraging, as no new men are usually put on before April 1."

Mr. E. J. Hunkey, of Trempealeau, Minn., has purchased the C. R. McGilvray stone quarry at Lamoille.

I. B. Woods and John B. Dewell have bought a large stone quarry near Canton, O., and will begin operations at once. It contains a good quality of fine red sandstone.

The Momence Stone Company, of Momence, Ill., has just been incorporated, and will at once begin crushing stone for roads.

The City Council, of Baltimore, Md., has just passed an ordinance, which has been signed by the Mayor, providing that no streets in that commonwealth shall hereafter be paved with cobblestones.

A. H. Cooley, of Omaha, Neb., superintendent of the Barton-Nash Stone Company of that city, has made a two years' contract with the C., R. I. & P. Railroad Company, to provide that great corporation crushed stone from the quarries at Coralville. The Barton-Nash Company are to supply the rock for the double track between West Liberty and Iowa City, and for other sources. There will be needed at least 65,000 yards of stone.

The council of Oconto, Wis., has decided to purchase a stone crusher.

The council of Raleigh, N. C., proposes to purchase a rock crusher. John C. Drewry, chairman.

The council of Gainesville, Fla., has under consideration the purchase of road machinery.

The council of Alma, Mich., has decided to improve the streets with crushed stone. A steam roller and stone crusher will be purchased.

Bedford is ahead of us in one thing. She has got a John R. Walsh. We need a man or two of that kind up here.—Bloomington, Ind., Star.

The County Commissioners, of Franklin County, O., have decided to issue $120,000 of emergency bonds to replace bridge and culverts washed out by the floods of 1898.

The construction of a bridge across the Monongahela River at Morgantown, W. Va., was authorized by the United States Senate.

Cleveland, O., March 1, 1899.

With the breaking up of winter weather the stone cutters are crawling out of their holes and looking for something to do. Little or nothing has been done since Thanksgiving week. From the present indications prospects are good in the way of small jobs and trimmings, enough, at least, to keep the home talent working. There will be only two large stone jobs coming out this summer, the East and South Side High Schools. The Board of Education is very much in need of these, so they will be pushed along rapidly, when started.

Among the jobs now coming out are the following: Bids for a church on Harbor street, estimated cost $15,000, Fugman & Ulbrich, architects, a modern structure of pressed brick, stone and terra-cotta, with steel frame; additions to Sowienski and Union street schools, estimated cost $25,000 each; a business block on Euclid avenue, for King & Moore. Architect F. C. Bate is working on plans for the West Side Opera House. Rumor has it that it is in contemplation to trim it with terra-cotta, and the stone cutters have a committee out to plead for stone as against terra cotta as a permanent building material. Improvements to the Sandusky Portland Cement Co. Works are being pushed. A new warehouse and other smaller buildings have been erected. The company has increased its output and effort is now being made to secure the products of a new gas and oil well, across the bay in Ottawa County. The company consumes about two thousand gallons of oil a day, which is shipped from Lima.

D. GWILYM GEORGE.

A Boom for Hallowell Granite.

Mr. C. E. Tayntor, of the firm of C. E. Tayntor & Co., New York, is to open up the old Melvin quarry, a mile and a half west of Hallowell, Me. The granite business has been dull in Maine and this revival will mean much to the cutters. It is expected that work will be begun about the first of April uncovering a couple of acres and getting off the grout. The Melvin quarry is one which Governor Bodwell used to work. From its ledges came much of the stone which went into the Augusta State House. All the big granite pillars on the portico were cut here. After the Governor took out all that could be gotten at conveniently, certain parties took the quarry and went to cutting paving stones. They used powder and blew things all to pieces, filling up two-thirds of the works with the debris. When they got through with it, the works were in such shape that no one could make a dollar out of it unless they had sufficient capital to clear it out and start in new.

The Lewiston, Me., "Journal" pays this tribute to the new owner: Mr. Tayntor is the leading builder of mausoleums in this country. Last year he put up twenty-one in different parts of the country, which is almost double what any other firm did. The third tallest shaft of granite in this country was erected by him at Woodlawn Cemetery, New York. It is a single block of granite, 51 feet high and 4 feet square at the base. It is said by granite men that Tayntor is to the mausoleum business what John Pierce is to the building trade, and when you stop to think that it was Pierce who handled the contracts for the completion of the Albany State Capital, the Chicago Post Office, and is in charge of the erection of the Hall of Records in New York, you appreciate the fact that the foregoing statement pays Mr. Tayntor a high compliment.

New Jersey's Work for Good Roads.

New Jersey, under her State Aid Road law, has expended $565,826.05 for good roads. Of this amount there has been spent north of Trenton $265,465.68. There has therefore been more money expended in the northern than in the southern counties of the State. North of Trenton 150 miles of roads have been built, and south of Trenton 174 miles, the southern counties getting more mileage for the money than the north. This excess is owing to cheaper construction, about 44 miles south having been built of gravel. With the exception of a few miles in Monmouth County the roads north of Trenton have all been built of stone.

Contracts and Building

Contract and Building News.

An extensive contract for masonry has been let to the Beaver Stone Company by Wilkins & Davison, engineers. It calls for the building of a retaining wall 600 feet long and 15 feet high, along the property of the Westinghouse Airbrake Company, at Turtle Creek, Pa. From 1,800 to 2,000 yards of masonry will be required. Work will be started as soon as the cold weather breaks.

Davidson Bros., of Chicago, have been awarded the contract for the marble work on the new county building at Detroit, Mich., their bid providing that the work is to be done for $211,000 if permitted to be done outside of Detroit and by non-union labor, or $230,000 if required to be done in the city and by union labor. The award is subject to approval by the board of supervisors.

Public Buildings and Schools.

The Mobile & Ohio, the Illinois Central and the Nashville, Chattanooga & St. Louis Railroads are preparing to erect a union depot at Jackson, Tenn. Richard Carroll, general manager, Mobile & Ohio Railroad Co., Mobile, Ala.

Hillman Hospital Association, of Birmingham, Ala., will receive sealed bids April 15 for the erection of a hospital building to be three stories. Cost not over $30,000. Mrs. T. H. Molton, secretary.

An appropriation of $50,000 has been made for a postoffice building at Janesville, Wis.

Proposals will be received at Miller county court house, Texarkana, Ark., on the 3d of April, for all necessary additional materials and work on the new court house.

J. W. Gladdis, of Vincennes, Ind., has prepared plans for a $25,000 school to be erected at Monroe, La.

A bill is before the California Legislature appropriating $100,000 for a Polytechnic school at San Luis Obispo, Cal.

Plans have been prepared for building a $20,000 school house in Freeport, Ill.

A site has been selected for the erection of a library building, at Battle Creek, Mich., this year. The late Charles Willard bequeathed $40,000 for this purpose.

The Chesapeake & Ohio Railway and the Pittsburg & Carolina Railway will build a union station, at Richmond, G. W. Stevens, general manager, Richmond, Va.

The Missouri Pacific will build a $40,000 station at Wichita, Kan. J. W. Way, St. Louis, Mo., engineer.

Plans have been prepared for a $50,000 school, with gymnasium and baths, in the 27th ward of Pittsburg.

Bids will be received April 6 for an insane asylum at Bloomfield, Ia.

The Allegheny, Pa., Elks will build a society building at Stockton avenue and East Diamond street. Estimated cost, $100,000.

Geneva, O., is to have a new school building for primary and grammar grades to replace building burned last fall. It will cost from $18,000 to $25,000.

The Douglas county, Kan., board has decided to build a new court house.

The Wesley Hospital Association will erect a hospital at Dearborn and 25th streets, Chicago. Estimated cost, $200,000.

Improvement to cost $50,000 will be made at the Michael Reese Hospital, 29th street and Groveland avenue, Chicago.

A movement is on foot to build a $100,000 Y. M. C. A. building, at Erie, Pa.

Stephen F. Sherman is receiving competitive plans for an opera house at Newark, N. Y., to be erected in memory of his father. Estimated cost, $55,000. Besides the theatre the building will contain gymnasium and club rooms.

The school board has decided to build a $25,000 addition to the Blain school, at West Superior, Wis.

Marshfield, Wis., will build a $19,000 high school.

Evanston, Ill., will build a $40,000 addition to its high school.

Senator Kimball has introduced a bill in the Arkansas Senate for the erection of a new State capitol building. The bill provides for an immediate appropriation of $50,000 to start the work. The bill further provides that the cost of the new State house shall not exceed $1,000,000, and that State convicts may be employed in the performance of rough labor.

Bids will soon be received for a new city hall at Lake City, Minn.

The Kansas Wesleyan University has received an endowment; $20,000 will be spent in erecting a ladies' hall and $5,000 for a gymnasium.

The Chicago, Milwaukee & St. Paul Railroad will build a $50,000 freight depot at Madison, Wis., of brick and stone.

Peoria, Ill., architects are preparing plans and specifications for five buildings to be erected on the State fair grounds at a cost of $100,000.

The faculty of Harvard University has decided to apply $50,000 of the Henry L. Pierce bequest for the erection of a building for the science school.

Competitive plans have been asked for the erection of a $30,000 school house at Gloucester, Mass.

The Southern Reformatory, of Indiana, is to have an addition containing 600 cells, to be erected at a cost of $205,000.

Among the new stations to be built in the spring are the following: At Council Bluffs, for $30,000, by the Rock Island; at Wichita, Kan., for $40,000, by the Missouri Pacific; at LaPrairie and St. Cloud, Minn., by the Great Northern; at Colorado Springs for $15,000, by the Santa Fe; at Benton Harbor, Mich., by the Chicago and West Michigan; at Ft. Worth, Tex., for $150,000 by the Texas & Pacific.

The Sisters of Mercy, of Chicago, are to build an academy and convent at 49th and 50th streets, and Evans and Langley avenues, at a cost of $250,000.

E. O. Fallis & Co., of Toledo, O., are drafting plans for the erection of a six-story building for the Y. M. C. A.

Churches.

The United Presbyterian Society, of Turtle Creek, Pa., will let the contract in a *week or two* for the erection of two $20,000 churches. Rev. William McConnell, pastor. The McMasters M. E. Congregation, of the same place, will also erect a $25,000 church. Rev. A. J. Ashe, pastor.

The North Avenue Presbyterian Society, of Atlanta, Ga., has purchased a site for the erection of a new church. Rev. Orme Flynn, pastor.

Money is raised, and work will be commenced at once on the erection of a $25,000 church by the Westminster Presbyterian Society, of Jacksonville, Ill.

It is proposed to begin work April 1 on extensive improvements to be made to the Second Congregational Church, at Oak Park, Ill. Estimated cost, $35,000.

The trustees of the St. Boniface Society, of Louisville, Ky., will build a $50,000 church. D. X. Murphy & Bros., architects. Rev. Paul Alf, pastor.

Mrs. H. N. May will erect a granite memorial chapel at Rosehill Cemetery, Chicago. J. L. Silsbee, architect.

St. John's Roman Catholic Church, of Philadelphia, will build a brick and stone-trimmed parochial school, at 13th and Chestnut streets. Architect Frank Watson is preparing the plans.

Media, O., is discussing the erection of a public hall and gymnasium.

An appropriation of $25,000 has been made for a normal school at Marquette, Mich.

Bids will be asked for an $80,000 school house at McKeesport, Pa. McCallum & Ely, architects.

The mayor of Troy, N. Y., recommends the erection of a new City Hall.

The State Assembly of Washington has passed appropriations of $600,000 for Capitol building, $100,000 for Pullman College, $55,000 for two domitories and $5,000 for a water system at the university.

The M. E. Society, of Anderson, Ind., propose to build a $30,000 church.

The M. E. Society, of Evansville, Ind., will build a $15,000 church after plans prepared by Sidney Smith, of Chicago.

The St. James' Episcopal Society, of Avon, N. Y., propose to build a $20,000 church. Rev. B. S. Sanderson, Bath, rector, in charge.

Hudson Hoagland is having plans prepared for a $100,000 Presbyterian Church to be erected in memory of his mother, at Dover, N. J.

The Catholic Society, of Herkimer, N.

Y., will build a stone church in the spring. Rev. James H. Halpin.

William R. Brown, of Cincinnati, has prepared plans for the church to be erected by the Central M. E. Society, of Wilkesbarre, Vt. Cost $50,000.

Business Buildings.

H. B. Eastman proposes to organize a stock company to build a $60,000 hotel, at Boise City, Idaho.

The Peoples' Institute Hotel Company has been incorporated to build a three-story hotel on West Van Buren street, Chicago.

A fourteen-story office building is to be erected at Court and Joralemon streets, Brooklyn. Architect, George L. Morse; cost $200,000.

The Moline (Ill.) Plow Company will build a warehouse and foundry at a cost of $90,000.

A ten-story fireproof business building is to be erected on Chant street, Philadelphia, by Contractor L. C. Hickman.

The Columbus (O.) Brewing Company will receive bids for excavating, stone work, brick work, iron work, machinery, etc., for brewery. Henry Seibert, president.

The Baltimore (Md.) council is investigating the cost of developing the power made by the 145,000,000 gallons of water which overflow daily at Lock Raven reservoir.

Swafford Bros., manufacturers of shirts and overalls, at Kansas City, Mo., will erect a $150,000 six-story building for business and manufacturing purposes.

Esenwein & Johnson are preparing plans for a three-story, $200,000 addition to the Iroquois Hotel, Buffalo, N. Y.

Architect William G. Van Kerren has prepared plans for a hotel on Van Buren street and Irving avenue, Chicago.

The Pullman Palace Car Company are to build large car shops at St. Louis.

The Long Island Brewing Company, at Third avenue, Dean and Bergen streets, Brooklyn, N. Y., will enlarge its plant. The company has issued $250,000 6 per cent. twenty years' bonds to secure funds.

A business building is to be erected at the northwest corner of Tenth and Washington avenue, St. Louis, to cost $175,000, to be fireproof, seven stories high, with terra cotta brick exterior. Isaac Taylor, architect.

Siegel-Cooper & Co. will erect a six-story extension to their building on West Eighteenth street, New York, at a cost of $100,000. DeLome & Cordes, architects.

The Monarch Brewing Company, of Baltimore, will erect a brewing plant at a cost of about $250,000. Wilhelm Guesser Engineering Company, architects.

Bridges.

Binghamton, N. Y., has awarded a contract to the Groton Bridge Company for a bridge to cost $40,000. It is to span the Susquehanna River at Tomkins street.

The Southern Railway Company will construct a steel bridge at Greenville, Tenn., to take the place of a wooden one.

The Board of Estimate and Apportionment of Brooklyn, N. Y., has received a communication from Bridge Commissioner Shea asking the board to authorize the expenditure of $750,000 for a bridge across Newtown Creek, at Vernon avenue, and $200,000 for one crossing at Grand street. Commissioner Shea will submit plans to the Board of Public Improvement for both of these structures and their construction will be urged as of most immediate importance.

Modena, Wis., is to have a new steel bridge with a 75-foot span.

There is to be a bridge built over a branch of the Cattaraugus Creek, between the towns of Persia and Otto in Cattaraugus County, N. Y.

The New York, Philadelphia and Norfolk R. R. Co., is preparing to construct a steel bridge at Pocomoke Station, Md., to replace the old wooden structure which now spans the Pocomoke River. The new bridge will cost about $75,000 and be completed May 1st.

The County Commissioners, of Terre Haute, Ind., are investigating the condition of the trestle on the Macksville grade. All the commissioners favor a steel or iron post trestle with small stone abutments and one of the contractors offered the opinion that such a structure would cost about $15,000 or $20,000.

The Mayor of Marion, Ind., is preparing an advertisement for plans, specifications and proposals for the new East Macon Bridge. It will soon be ready for publication.

Beds of Onyx Found in Kentucky.

A rich bed of onyx has been located in Barren County, Ky., and will be developed this spring. A correspondent gives this account of the find:

Six months ago a mining engineer of many years experience, employed by Louisville, while making a geological examination in Green County, Ky., along Little Barren River, came upon groups of onyx deposits. These deposits were located on the slope of a range of hills forming one side of a basin of the river. The peculiarity of the grouping in this region is that several deposits varying in area from a few square rods to several acres, are found together, and then for miles the sides of the hills show no trace of onyx. In rare instances single or isolated deposits are found.

The deposits of onyx thus far have been only found on the slopes of the knobs bounding the west side of the Horseshoe Basin. These deposits, like those in Green County, are chiefly in groups, with miles of intervening country practically barren of onyx. Some of these deposits are the largest ever found. One on the Smith farm, from its lower edge to the crest, extends about 200 feet up the slope, showing a thickness of 60 feet.

The onyx is sound and usually has none of those flaws which sometimes mar the beauty of the Mexican product.

Since the discovery of this field about 1,200 cubic feet of the material has been shipped. This has been sawed into slabs and polished either for use in decorative work or mantels, or made into table tops.

The onyx was shipped to New York, Philadelphia, Cleveland, Cincinnati and Louisville, and wherever it has been used it has been admired.

The Famous Pipestone Quarries.

Major James McLaughlin, Indian inspector, has undertaken a heavy task, says the "Minneapolis Journal." It is nothing less than to persuade the Yankton Sioux to give or sell to the United States the mile square near Pipestone, Minn., which contains the famous pipestone quarries. The absolute title to this land, which contains the only stone of the kind in the world, a stone the Indians have for centuries valued above all others, is vested in the Yankton band. Only by their own free will can they be deprived of the land. The government wants the mile-square for more room for the Indian school, which it desires to enlarge. The task is likely to be a very ticklish one, for the pipestone quarries are the sacred of sacreds to the Indians, especially the Sioux, who have always jealously guarded them. The pipestone quarries cover about a quarter of the section and are the bed of a creek. Major McLaughlin says that he hopes to succeed by guaranteeing to the Indians that the famous quarries will always be theirs, even if they cede the land to the government.

Major McLaughlin is at work now in counting the scattered members of the Mdawakanton band of Sioux, who live in different parts of Minnesota. The governors put their number at 940, but the Indians say they are not so numerous. It is to their advantage to be few in number, that each person may get more of the $5,000 annuity.

A Boulder Monument to Cuban Heroes.

Buffalo is about to erect a boulder monument to the gallant men of the brave Thirteenth infantry who did such noble work during the recent war at San Juan Hill and before Santiago. This boulder has been taken from the hillside of the Lewiston Mountain, on the lower Niagara, and will be erected on a low foundation at Fort Porter, Buffalo. It is of red granite, egg-shaped, and is ten and one-half feet long, nine feet wide and seven feet high.

Building Statistics of New York.

The report of the New York Department of Buildings for the last quarter of 1898, just published, shows that during the three months ending Dec. 31, plans were filed for 2,343 new buildings. The estimated cost of the buildings was $22,144,965. Of the buildings, 854 were in the boroughs of Manhattan and the Bronx, and their estimated cost was $16,655,025. The new buildings in the borough of Brooklyn for the same period numbered 1,175; estimated cost $4,606,259.

The new buildings in progress in the boroughs of Manhattan and the Bronx on Dec. 31 numbered 1,969.

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Stone or Steel Bridges?

Alderman William Hall, of Des Moines, who introduced a resolution in the city council for a brick bridge across the river at Des Moines, says:

"I have been looking into these bridges and find they are becoming the favorites in the east. One at Topeka cost over $100,000, but that was because of the scarcity of materials. I have statements from several engineers, among them a Kansas City man who all say the brick or stone structure is the best and cheapest, regardless of statements of the steel bridge combines. I find that with the sand and gravel close at hand, plenty of broken tile and brick for concrete and the best paving brick at low prices, we could build a bridge of the Melan Arch style for about $3 per square foot, which would bring the entire cost at from $30,000 to $40,000. These bridges become simply a solid mass of concrete or stone and will out-last steel bridges ten years to one. Steel structure begins to decay as soon as built from rust and weather, while the cement structures get harder and are practically weather proof. All I want is that the council shall investigate thoroughly before ordering or contracting for any more bridges. Almost every dollar would be spent for home labor and materials. The Trades Assembly endorses these bridges and so will every laboring man who studies the question."

A New Monument to Lincoln.

There is a disposition on the part of the members of the House of Representatives to erect a new monument in memory of the martyred President, Abraham Lincoln, says an Illinois exchange.

For some time the fact has been conceded that the present monument, at Oak Ridge Cemetery at Springfield is fast going to decay, and it is estimated that it will take over $250,000 of the State's money to put it in repair; the only way to make it serviceable being to tear the structure down completely and erect a new one in its place. The present monument was built by the Lincoln Monument Association, by popular subscription in various States, and was turned over to the State of Illinois in 1895. Upon examination a year ago the foundation of the monument, beneath which rest the remains of Pres*ident Lincoln,* was found to be in a badly dilapidated condition. The brick walls are full of large cracks, and prominent architects have given opinions that these walls cannot much longer hold the massive weight resting upon them. The monument question has been talked over among the members of the House considerably since the opening of the session, and many are now free in expressing opinions in relation to it. The disposition of the members of the House who have given the monument question consideration is that a new monument should be erected, and a bill making an appropriation for that purpose will be introduced early in the week.

The present intention is to erect a new monument in the public square of Springfield, which at present is occupied by the old courthouse. The old courthouse was formerly the State capitol building, and it was in it that Lincoln became first famous.

The Pumice Stone King.

William Quigley, the pumice stone king of the United States, is in the city, says the Salt Lake City "News." Mr. Quigley's home is in Cleveland, O., though his pumice factory is in Chicago. He is the owner of the pumice stone deposits in Millard county, Utah, which is the only deposit thus far found in the United States. Heretofore all the pumice stone used in this country came from Italy. At present the American article is driving the foreign one out of the market. From tests made the Utah pumice stone is found to be superior to any yet imported. Mr. Quigley has a force of men at work at the quarries, and already two carloads of the product have been shipped to the Chicago factory. In an interview to-day Mr. Quigley said that he had used up all the stock on hand and that shipments would continue from Utah until the factory was filled up. He predicted that before long 250 men would be employed at the quarries.

It is the intention of the County Commissioners of Madison County, O., to erect two bridges as follows: One over Deer Creek on the London and California pike: 170 feet by 18 feet span, and 400 perches of masonry. One over Bradford Creek, Shepherd road, in Range township, 60 feet by 14 foot span and 140 perches of masonry. W. D. Wilson, County Auditor.

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Washington's Green Onyx Marble.

A carload of green onyx marble, the first shipment of dimension stone from the quarries of the United States Marble Company, near Valley, in Stevens County, Washington, was recently shipped to Chicago. Mr. John Kinan, vice-president of the company, talked about the product of the mines to a reporter. He specially pointed out a block of the onyx, measuring about six feet in length and three and a half feet square on the end. Its weight was about five tons.

"That block alone is worth about $300 even at the introductory prices which the company obtains for its material," said Mr. Kinan. "This material brings $5 per cubic foot at Valley and the invoice for this carload is about $980. This sum of money is about equal to the total cost of the machinery installed upon the property and with which this carload was taken out. It will be seen therefore that the onyx quarries are destined to prove as profitable as any gold mine, and the cost of getting out the material is trifling as compared with that of mining ores. We have never had to do much dead work. No shaft or tunnel has been necessary. A giant body of this rare material crops out upon the mountain side 2,100 feet above the level of the station at Valley. This body has been proved to be over 200 feet wide, and how much farther it extends into the mountain is still a problem. That it goes down to great depth is proved by the showing of the same material in the canyons 300 to 500 feet below the point where the work is being done.

"In getting out this material it was only necessary to blast away a little overhanging cap rock, and then to open the onyx deposit in the usual quarry benches. One Rand drill mounted upon a quarry bar gets out the material, although it is the intention of the company to add to this plant one and possibly two drills at once.

"The process of getting out the blocks is by drilling holes about five or six inches apart and on all sides of the block and then swedging out the intervening material between the holes, thus freeing the piece on all sides. No powder can be used, as it shatters the material. The drill can make a four-foot hole in this material in about 20 minutes."

This property has been under development only about a year. Last spring a small carload of the material was shipped. It consisted of fragmentary pieces from the surface, showing, when worked up, many flaws. The material made a hit in Chicago, but the marble men down there would not believe that it could be furnished in blocks of any size. This carload will convince them not only of the fact that big blocks can be obtained but that the material, at only a slight depth, is flawless. Careful tests, made by hand polishing, show the material like that in the car to be perfectly solid and free from cracks.

Forests of Stone.

Old forests are apt to get into the most impossible places and to turn into the most preposterous shapes. All our coal fields are ancient forests far underground, then crushed and cooked into a hard mineral substance, says the Chicago Tribune. They are forests of plants which once grew as mighty trees, for outside of fairyland who would ever imagine a majestic woodland of club moss and reeds and the little sand weed called the horsetail?

In Greenland, right under the ice fields, a buried forest has been found in which the plants were all palms and tropical creepers, proving that once the Arctic regions were as hot as the Indies.

In the Wash, between the counties of Lincoln and Norfolk, there is an old forest under the sea, with stumps of fallen oaks and elms still visible when the tide is low. This was all dry land in the days of the ancient Britons.

Out in the deserts of Arizona there is a dead forest on the surface of burning rock and driving sand, where no plant save the cactus can now find any water. When the place was first discovered a negro cook thought that it would be excellent for camping. So he took an ax and delivered a mighty blow upon the fallen trunk of a big red pine.

His ax head was ruined, the haft smashed and his fingers so badly hurt that he sat down and howled. For that tree was changed to massive rock, which looked as fresh as though felled but yesterday. The whole prostrate forest of big timber had been changed into valuable and beautiful onyx, jasper and agate.

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A Huge Block of Magnesium Limestone.

The Illustrated Carpenter and Builder, of London, describes the largest stone ever delivered in the city of Exeter, which arrived there the other day via the Midland and South-Western Railway.

It consisted of a huge block of yellow magnesium limestone, raised in Messrs. Lindley and Sons' quarries at Mansfield, in Nottingham, weighing 9 tons 18 cwt., and containing no less than 165 cubic feet. Had it been more than 2 cwt. heavier the cranes at the Queen street goods station could not have lifted it, the utmost lifting capacity of the largest not exceeding ten tons. This immense stone is destined to form the colossal figure of the crucified Christ, which Messrs. Harry Hems & Sons, the well-known sculptors of Exeter, have been commissioned by Lord Aldenham, of Aldenham, to execute for the high altar screen at St. Alban's Cathedral. Magnesium limestone is a rare and costly material, more expensive indeed than is the best Sicilian marble. It is expected to take fully six months to carve the figure.

Norman Construction.

The skill of the Norman builders in the science of construction is attested by the strength and durability of their structures. The three essential ingredients of which they composed their walls—squared stone, rubble and cement—when combined could be equally relied upon for their firmness against pressure, or their resistance for a very long period to the operations of time and weather. The system, therefore, of bonding or tying together the ashlar-work on both sides of the wall was very rarely practiced, and there is not an example of it in a wall of great thickness. The practice would have been useless; solidity and capacity were indispensably requisite to Norman construction, and the concrete was so dexterously composed that it would have derived no advantage from the introduction of blocks in a transverse direction. For the same reason neither timber nor iron were concealed in walls thus composed. The rugged, rock-like aspect of many buildings which once exhibited a well-wrought surface of stonework mingled with the elegant ornaments of architecture proclaims the toil with which their strength had been secured. Fountains Abbey and St. Pancras Priory at Lewes are interesting and deplorable examples; but in still stronger confirmation of the durability of ancient cement, there are places in the walls of Conway and Bamborough Castles, where the stone has been forced from the mortar, which protrudes in large and prominent masses, and which are not in any perceptible degree injured by the weather. Another peculiarity occasionally observable in the construction of Norman masonry is that the angles of openings and the mouldings or piers composing the jambs attached to them are not bonded together, but that every member of the jamb throughout the thickness of the wall consists of distinct and similar layers of stone, which when not compactly joined and firmly sustained by cement become crippled by length of time, and fall asunder beneath the pressure of their arches. The tower of Canterbury Cathedral was a remarkable instance of this imperfect kind of construction.

Tunnelling Through the Quirinal.

It is intended to construct a tunnel through the Quirinal, Rome, a measure which is shortly to be accomplished under the all-embracing formula of municipal improvement. The Quirinal Tunnel is to be about 20 yards wide, and will serve as a thoroughfare for pedestrians, carriages and a new electric tram line. The execution of the work will, it is estimated, take some seven months to accomplish, and the municipality of Rome will place it in the hands of private contract. The Quirinal Tunnel is not to be a horizontal cutting; it will have an ascent through the Quirinal Hill to the higher ground of the Viminal and the Esquiline, uniting by tramroad and footpath the higher parts of Rome with the town districts lying in the plain. The new Quirinal electric tramway will start from outside to Porta del Popolo to the north of the Imperial City and end at the Porta San Giovanni in the south.

There is a movement on foot to erect a $20,000 swing bridge at Tupperville, Canada.

The Bridge Committee of Detroit, have decided to report in favor of asking the legislature for authority to issue bonds for $500,000 for a new bridge at Belle Isle.

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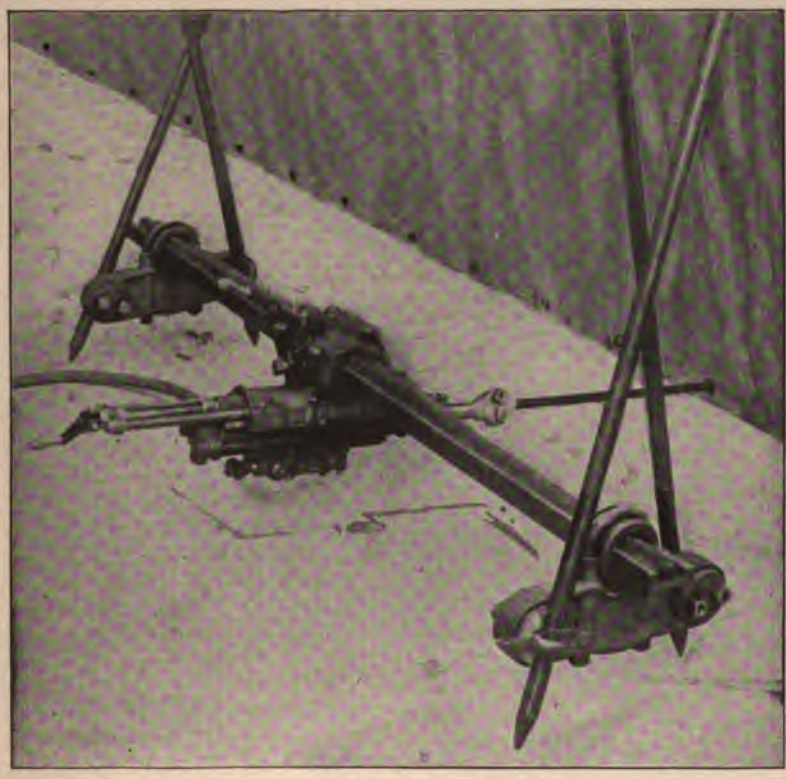

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Sources of Graphite.

Since the Cumberland and also the Siberian deposits of graphite or plumbago have been practically exhausted, the chief supply of this mineral has been derived from Bohemia, in the south of which country, near Schwartzbach and Murgan, deposits of pure graphite are found in the gneiss, accompanied by crystalline limestone. According to the Society of Arts Journal, the mines and works at the former place are owned by Count Schwartzenburg, and those at the latter by the peasants, and these two centers yield the purest graphite available, that of Krummau being far inferior. When the mineral is not sufficiently pure to be sent away as natural graphite, it is ground in mills constantly traversed by a stream of water that takes up the powdered graphite, which is afterwards thrown down in the form of mud, and when the mud layer has attained a sufficient thickness, it is subjected to a pressure of 88 lbs. per square inch, in a filter press; the resulting cake, containing more than 20 per cent. of water, being then dried in a stove heated to 90° or 100° Fah. for twenty-four hours. Out of the 885 tons of graphite which are turned out yearly on an average in Bohemia, two-thirds are exported, but it is only during the last few years that the production has been considerable. Out of the twelve graphite mines in Bohemia, only the three named above are actively worked, occupying 728 hands. Although the prices of graphite, and especially natural graphite, have slightly fallen since, the best quality now obtains only 28s. 7d., instead of 38s. 4d. per metric quintal (2 cwt.), as formerly, the mean annual cost of production has increased from 6s. 0½d. to 9s. 7¾d., owing to the better qualities being more in demand that the inferior.

Beginning a Stone Building at the Top.

The Washington correspondent of the Chicago "Journal" says:

In building the new Chicago postoffice and federal building the stone work is to begin at the top and progress downward. So I am informed by Mr. Cobb's architectural department. The iron work of the central section of the structure will first be *thrown up, the corner* wings being delayed so the space may be used by the contractors. Then, after the roof has been put on, the granite will be adjusted to the iron skeleton and be draped to the ground. Such is the revolution which has been wrought in the art of building. Three of the principal iron firms in the country are now at work on the frame, while at Mount Waldo, Me., 600,000 cubic feet of granite is being cut into blocks of the proper shape and dimensions. The weight of the stone used in the construction of the building will be 103,200,000 pounds.

Heroic Figures in Stone.

The "Peace" group on the west side of the soldiers' monument is nearly completed. Like the "War" group, on the opposite side of the monument, the "Peace" figures are carved out of oolitic limestone from Indiana quarries. There are about a dozen of the figures, all of heroic size. The central one is that of Columbia, twenty-four feet high. In the hand of the figure is the American flag in stone, on top of the staff of which is perched an eagle with outspread wings. At her feet is a negro, with a broken chain in his uplifted hand, typifying the end of slavery. Near the negro is a figure of a man with a broad stone apron spread over his knees, signifying industry. Back of him stands an American soldier, swinging his army hat as if cheering for the end of a war. On the right of the central figure stand representatives of American womanhood and childhood. Above and to the rear of the group is an allegorical figure of Peace flying through the air, with a long palm in one hand and an olive branch in the other.

Rudolf Schwarz, who has carried out the design of Bruno Schmidt in the group, says that some of the figures in it are the largest that have ever been carved out of stone since the early days of Egypt, when some figures of kings were made which equal in size those on the monument. He says Europe offers nothing which will compare in size with the stone figures on the monument.—Indianapolis News.

The Bremes County (Iowa) Commissioners are considering the construction of a $10,000 bridge across the Cedar River. Geo. Watts, County Surveyor, Waverly C. H.

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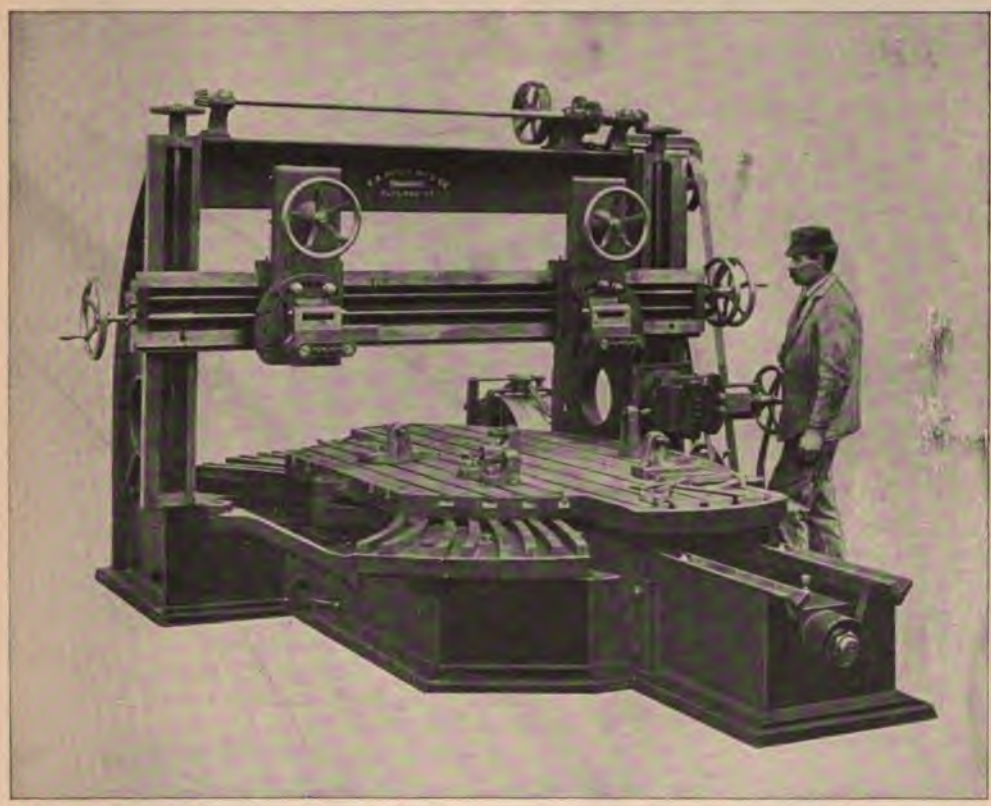

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Balance in Building.

There is a kind of beauty in invisible objects which is commonly, but perhaps falsely, supposed to speak to the eye; this is that kind of symmetry or uniformity which consists in an exact correspondence of form between the two halves of an object, says "The Illustrated Carpenter and Builder." To distinguish it from other kinds of uniformity we will call it "the uniformity of halves." We need hardly observe that it is the most universal quality in nature pervading all ranks of organic life, from the leaf and the flower up to man, and all separate and distinct creatures, even when inorganic, from a crystal to a world. Accordingly, man has in all ages and countries imitated this principle of nature to the very best of his power, in every work that was intended to appear one separate and complete whole; and though some late critics have told us that a building containing distinct apartments is to be regarded as a collection of several things and treated accordingly, the world will never believe a mere assertion against the plain example of nature, whose practice it is, in an animal having no uniformity of internal parts (a heart on this side, a liver on that, and a stomach placed unsymmetrically), nevertheless to contrive the external form with an exact correspondence of halves. Though we constantly speak of this quality as being pleasing to the eye, there seems to be a continual proof that it has nothing to do with the eye, for when is the image of a uniform object (formed on the retina) uniform? Never, in the case of a solid body, because even when the eye is exactly in the central plane of the object, though the outline be uniform, the lights and shades (far more striking to the eye) destroy that uniformity. Thus even the elevation of a uniform building ceases to be a uniform object as soon as it is shadowed. But, besides this, a deviation of the eye from this central plane to any extent is universally thought to increase the beauty of the view, though it destroys the uniformity of the outline and renders it impossible that the ocular image can, under any effect of light and shade, ever be uniform. Thus it appears that the same uniformity which is a beauty in the object is a defect in its image or picture. It is necessary to the enjoyment of this excellence in a building that it be not seen but discovered by the mind.

The House of Three.

The most peculiar house in Great Britain is said to be a small triangular building erected about 300 years ago at Rushton, in Northamptonshire, by Sir Thomas Tresham, a fervent Roman Catholic, who is supposed to have wished by his design to typify the Trinity. The house is all threes, each of its three sides being exactly 33 feet 4 inches—that is, 33⅓ feet—in length. There are three stories; each has three windows on each of the three sides and each of the windows in two of the three stories is in the shape of a trefoil—the three-leaved shamrock. The panes of glass are all triangles, or three-sided. In each of the other windows there are twelve panes of glass, in three fours. There are three gables on each side rising from the eaves; and from the center, where their roofs meet, rises a three-sided pyramid, terminating in a large trefoil. The smoke escapes from this chimney by three round holes on each of the three sides. On the top of each gable is a three-sided pyramid covered with a trefoil. The building is almost covered with inscriptions and carvings. Three Latin inscriptions, one on each of the three sides, have thirty-three letters in each. Three angles on each side bear shields. Over the door is a Latin inscription of three words, meaning "There are three that bear record." Inside the house each corner is cut off from each of the three main rooms, so that on each floor there are three three-sided apartments. It may be interesting to note that the house is not inhabited.

Big Government Contract.

Bowe & McKenzie, of Augusta, Ga., have been awarded a big government contract for furnishing crushed rock at Savannah. They have extensive quarries at Lithonia, Ga., where they will get out the rock for filling the order. There were quite a number of large concerns among the bidders, but Bowe & McKenzie submitted the lowest figures, $30,558.50. Beside this contract, the firm also has secured that under A. J. Twiggs to furnish crushed rock for the reservoir of the new waterworks of Augusta.

Bids will soon be asked for building the proposed bridge at Mill street, Providence, R. I. Estimated cost $21,000. O. F. Clapp, City Engineer.

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FOR SALE OR LEASE.—Quarry of the Rock River Brownstone Co., near Marquette, Mich. Will sell or lease this property on a royalty. Machinery for operating on the premises. Correspondence solicited. Address W. I. BROTHERTON, Bay City, Mich.

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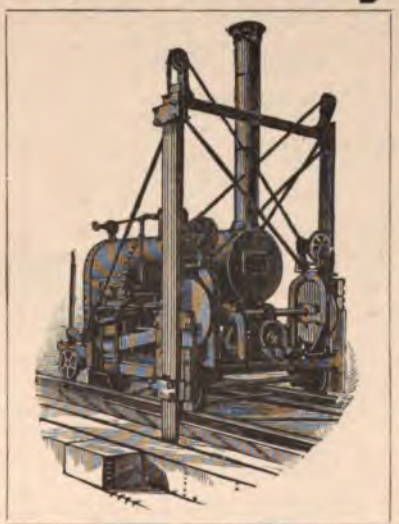

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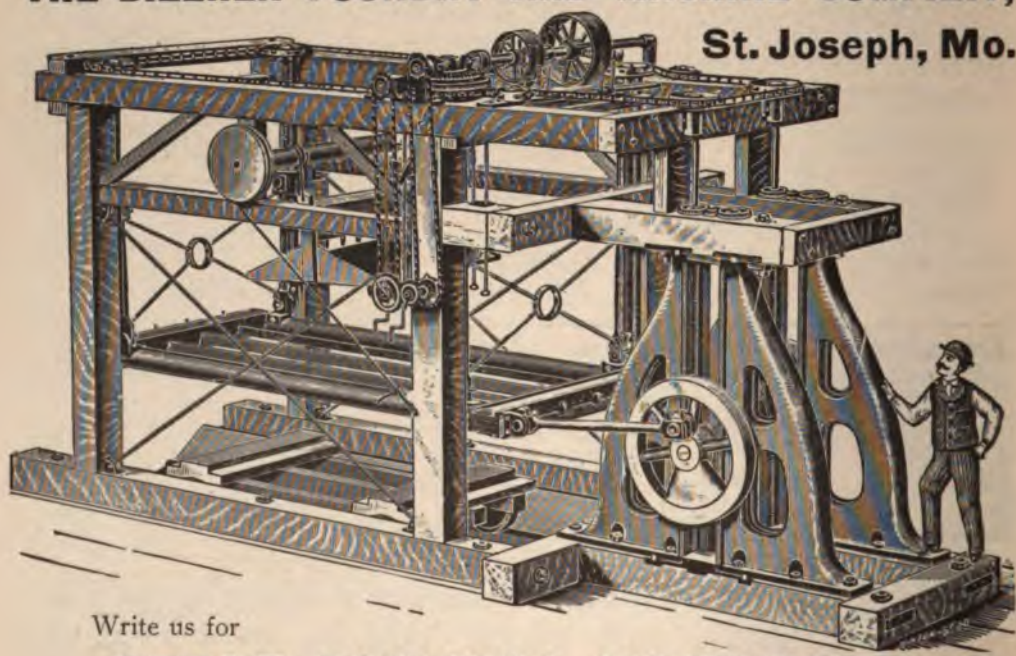

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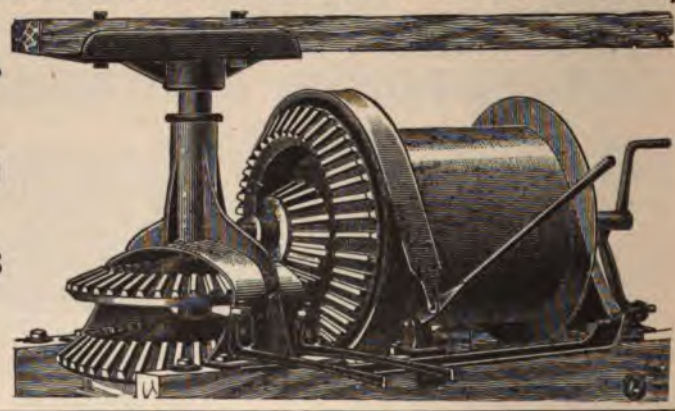

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STONE.

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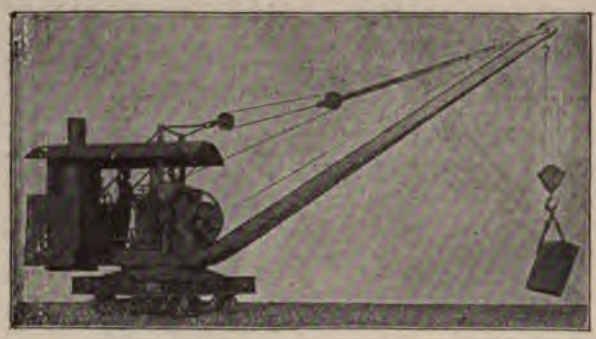

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FAMOUS SINGLE STONES.

HERODOTUS tells us he saw a colossus of Osiris, in Egypt, which was 93 feet in height. A few years ago there was exhumed at Memphis a granite statue of Rameses II., which must have been 49 feet in height. These statues were carved from single blocks of red granite. Before the entrance to the palace of Luxos there were four colossal figures, which though seated, measured fully 40 feet in height. Near Gournah there are still the fragments of a gigantic statue of Rameses the Great, represented seated. It was cut from a single piece of rose granite, and must have been 57 feet in height and have weighed more than 2,000,000 pounds. The two colossi of Memnon, although seated, measured more than 62 feet in height, and, with their pedestal, had a weight of more than 2,800,000 pounds.

There are immense stone idols in India and China, all of which are cut from single stones, and in Mayalipmen, India, there are seven small temples, each of which has been carved from a single granite bowlder. Some idea of the task of chiseling out these beautiful places of worship may be obtained from the fact that one of these temples is twenty-nine feet long, twenty-seven feet high and eighteen feet ten inches wide, while the smallest is twenty-four feet high, by seventeen feet six inches long, and a trifle over twelve feet wide. These temples are marvels of beauty, and the carvings on them in places are as fine as lace work. The date of their construction is unknown, but they are believed to be over fifteen hundred years old. Experts say it must have taken centuries to complete these wonderful works.

In modern times the most noted of single-stone statues are those of the great fountain of Neptune, in Florence, the story of which has been well told in these columns by Arthur Lee; the statues of David and Moses, by Michael Angelo, and the Lion of Lucerne, by Thorwaldsen, the Danish sculptor.

There is some romance about the latter statue, which was erected by the Swiss people in memory of twenty Swiss officers and seven hundred and sixty soldiers, who lost their lives in 1789 defending the King of France, when his palace was stormed by the mob, and his own French soldiers had fled and *left him to his* Swiss Guards and fate. These brave men fought

like lions against the howling mob, until all went down to their deaths. Not long after this, Switzerland became a republic, and then the people, wishing to commemorate the event and leave a lasting tribute to the brave fellows, engaged Thorwaldsen to carve them a lion out of the living rock near where the guards had once lived. The lion, which represents strength, is twenty-eight feet long, and is guarding with his torn and bleeding body the lilies and cross of France, the emblems of her greatness.

There is a Latin inscription under the figure, which translated means: "To the fidelity and valor of the Swiss, on the tenth of August and second and third of September, there are the names of those who fell most bravely fighting, that they might not fail in fidelity to the oath." Then the names of the officers and soldiers who died defending a foreign king—and an undeserving one—follow.

"Each of the heroes around us has fought for his land and line;
But thou hast fought for a stranger, in the hate of a wrong not thine.
Happy are all free peoples too strong to be dispossest,
But blessed are those among nations, who dare to be strong for the rest."

FRED. T. HODGSON.

STONE TURNING.

JOHN DORMER has written an article for an English paper that is full of suggestions for stone turning. The rigors of the American climate are such that soft stone, suitable for turning, is not viewed with favor by architects and builders, but there are some uses to which this form of ornamentation can be put with excellent results.

To turn hard stone and granite work requires special and expensive tools and steam power. Bath stone is very often required to be worked into a circular form, and sometimes very good and elaborate moldings are wanted. In articles such as small columns for portions of pulpits or fonts, or gallery fronts for church work, and for balustrades for bay windows or tops of houses, a great deal of labor is often expended in working, by hand, and principally with a rasp, small and delicate moldings. The result is never very satisfactory. Much time is spent with but little result. All these things can be turned in any common lathe, and with very little knowledge of turning. It does not require any great practice, as is the case in learning to turn wood.

The stone which lends itself most readily to the turner's art is either Corsham or Farleigh, both being varieties of what is known as Bath stone. Of these two kinds Farleigh is the softest and easiest turned, but is not suitable for either very large or very small moldings. If used in large pieces, such as, say, 2 feet diameter and 1 foot 6 inches thick, its weight is such *that it needs* very careful handling or it will get flushed. Flushed is a trade

term used by masons, and simply means that a small piece will break out of the edge or off a corner if the weight is allowed to rest for only an instant on these parts.

If used for small work it cannot be turned very thin, or, being soft and brittle, it will break in two pieces. For moderate sized pieces and for inside work it is very suitable. By moderate sized pieces I mean anything from 9 inches high and 4 inches diameter up to 2 feet high and 9 inches or 12 inches diameter.

I have repeatedly seen stone balusters 1 foot 6 inches high and 6 inches diameter, with 12 moldings on them, put in the lathe (a treadle lathe) after being roughed out to an octagon form and finished complete in half an hour each. To work one of these by hand would take a good mason over three hours. An ordinary wood turner's lathe with a rough T rest and socket is all that is required.

For tools, some old three-square files are required. The best thing to do with these is to soften them first by putting the ends into the fire until they are of a dull red color, then throwing them into the ashes to cool gradually. The reason for this is because the stone cuts the tools away very fast, and if they were hard it would mean that you would have to pay frequent visits to the grinding stone to sharpen them. By having them somewhat soft they can be filed up in a minute or so without leaving the place at all. Simply lay them face down on the rest and file away the back. Having, say, three files softened, file one to a point like a V, another to a rounding edge like a gouge, and the other to a square edge. Many moldings can be worked with these three simple tools.

A chisel is also wanted, say an inch carpenter's chisel, such as every mason has with him in constant use. Also an old worn out plane iron for finishing the straight parts with. The stone by itself will not run in the lathe, as the material is not hard enough to hold the centers. To obviate this difficulty get two square nuts suitable for an ordinary $\frac{3}{8}$-inch bolt and let one into each end of the stone in the center. It is necessary that these nuts fit the stone fairly well without shaking about. Then bore with a common drill a $\frac{1}{2}$-inch hole about $1\frac{1}{2}$ inches away from the nut on one end. Drive a plug of wood into this and turn a stout screw partly into the wood, leaving about an inch standing out. This is to meet the carrier on the lathe and to drive the stone around. Oil the other end before putting it in the lathe, and then put it in position and screw up moderately tight. Then begin the work by using the V-shaped tool first, and bring it down to a circular form all along and get your ends nearly to the size required when finished. Now set it out. This is done by having a piece of thin wood like a lath. A lath would do, but it is better for being planed. Lay this lath on your drawing and mark off each member by making a line where the quirks come for the beads, and where the edges come for the hollows. Square these lines across the lath; make the marks plain, as the stone dust soon rubs out faint ones. Hold this stick up against the work and revolve it slowly, and pencil off the lines as you have them on the stick. Now, with your V-tool, mark in these and sink away with the gouge tool any parts that are wanted smaller. If you have a lot to cut away you need not trouble to turn it all away to dust; simply run the

gouge into the work in a series of grooves about one-half-inch apart and then stop the lathe and gently tap the remaining pieces with the side of the tool, and you will find they will break off with just no trouble at all. Don't run your grooves as deep as you want to go by about one-eighth inch, as they may pluck a little. Pluck is another trade term, and is used to describe what happens when a mason takes off too much with his chisel, and the chisel or other tool, being unable to cut so much, tears it out, and deeper than is wanted. So be careful and don't have plucks. When the stone is roughed out into nearly its proper form sharpen the tools and take a light cut for the finishing one. It is also necessary to shift the rest nearer the work after cutting so much away. The rest should be from one-quarter inch to one-half inch away from the largest part. It need not be straight along. One end can often be placed pointing inward toward the work. The main thing is to keep near enough so as not to have a slip. When a slip is made, the point of the tool catches in the work and tears out more or less. The handle generally comes up in a hurry, very often being stopped by the turner's chin or some part of his face. However, these little mishaps all have their uses and tend to make one careful. Finish the squares and little fillets with the chisel, taking care to have the corners sharp; for any long rounds, or for the shaft, or for flat bands, the old plane iron will be useful. Now, with a piece of coarse sandpaper, go over the work and take off just the rough marks left by the tools. Don't do much with this, or the beads will be flat and the sharp arises lost. Then, last of all, cut down with the V-tool your shoulders or ends, as the case may be. Go down as far as you can, and undercut just a little. Then carefully remove the work and see how much superior it is to any possible work done by hand.

THE PONT NEUF, PARIS.

The most famous bridge to be seen in Paris is the Pont Neuf. It was begun in 1578 under Henry III. from the plans of Androuet du Cerceau. The wars interrupted its progress, and it was recommenced in 1602 under Henry IV., being completed in 1607.

The river Seine is divided at this point by an island, and the bridge is in two sections, one on each side of this island. One section has seven arches ranging from 46 feet to 62 feet 4 inches in span, while the other section has only five arches ranging from 31 feet 3 inches to 48 feet, all the spans being semi-circular.

The entire width of the bridge is 72 feet, part of it overhanging the arches, being supported by brackets. The piers have triangular cut-waters, which carry triangular counter-ports up to the cornice.

The space between the two portions of the bridge is ornamented by the equestrian statue of Henry IV. Here is where Napoleon made his famous stand during the French Revolution, before his name had been made famous.

THE PONT NEUF, PARIS.

The splendid condition of the masonry after such long usage, under very heavy traffic, attests the careful study given to the design and the care with which the work was done. The bridge is not an example to be copied with profit, but is an example of the character which is given to an engineering work by a massive design. "F."

THE FRIEDRICHSBRÜCKE, BERLIN.

The architecture and the public works of Berlin are hardly less noted than those of Paris. The National Gallery, which can be seen in the view, is one of the most elegant examples in existence of the modern use of classic architecture, and shows the fine effect of such a background for a chaste bridge design.

The bridge is supported on cut stone piers having curved cut-waters which are appropriately capped. The arches spring from well defined skew-backs, the arch rings being finely molded and standing out in relief from the spandrels. The neat coping supports a beautiful balustrade, with a dado of openwork, having solid paneling, however, at the shore half of the end spans and paneled pilasters at the center of the adjacent spans.

Over the piers are pedestals which are bracketed from without and which support statuary carrying lamps. "F."

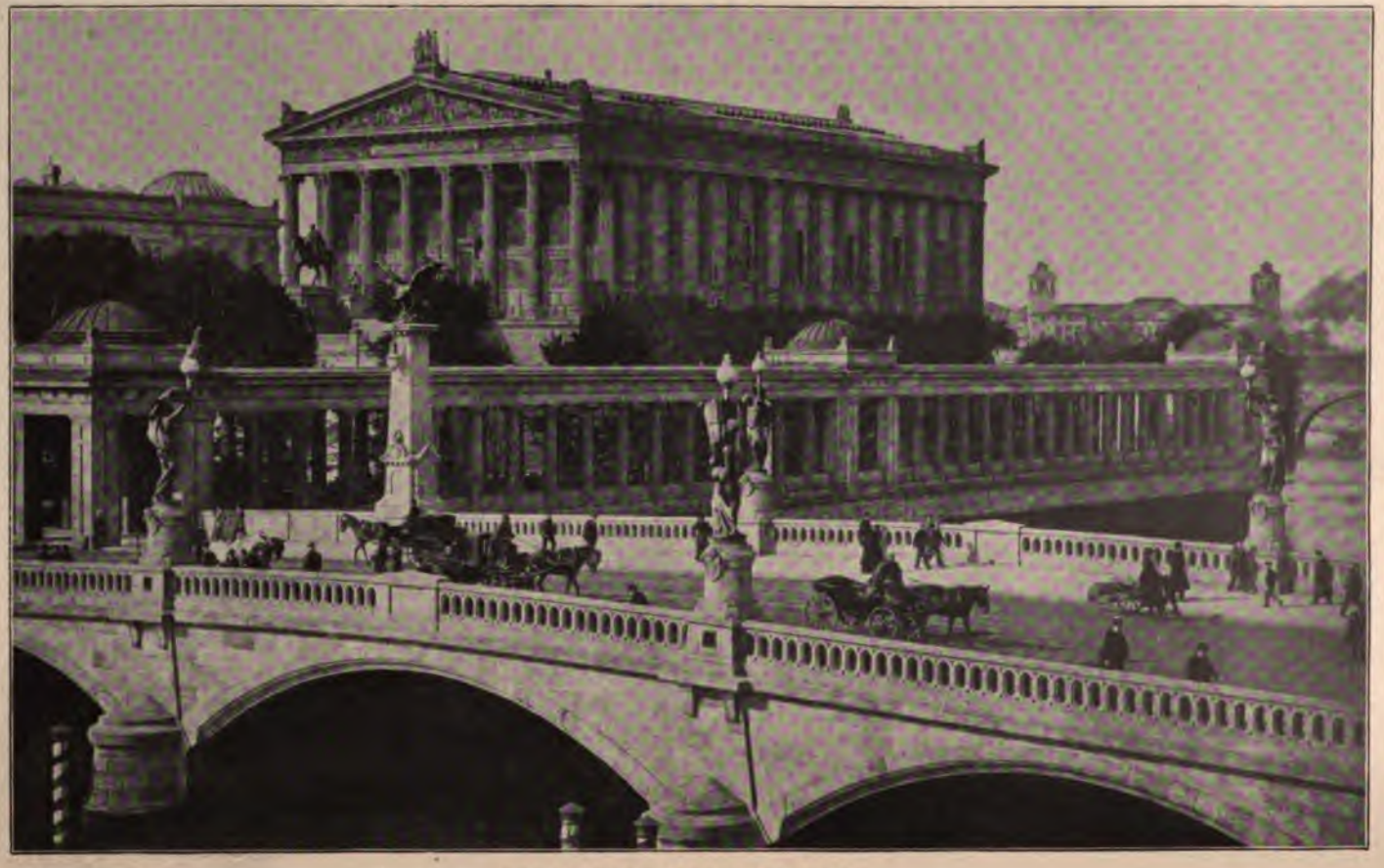
OPENING FOR STONE CRUSHERS IN GERMANY.

Mr. Ernest L. Harris, the American Consular Agent at Eibenstock, writes under date of March 4, 1899:

"Our manufacturers of stone-crushing outfits, tile ditchers and sewerage apparatus would, in my opinion, find a market in Germany. This Empire has perhaps the best system of country roads in the world. Not only are new roads being continually built, but the old ones are repaired every five years. The stones are all crushed by hand with sledge hammers. From the car windows, one can see piles of stone extending for miles along the roads, waiting for the workmen to commence the long and tedious task. In many of the stone quarries, one can see huge piles of uncrushed stone ready to be carted away. An American steam stone crusher would accomplish marvelous things if set up in one of the quarries.

"The best method for an American manufacturer, if he wishes to introduce these machines into Germany, is to secure a contract from the Government, either State or municipal, to do a certain amount of work for a definite sum of money. Nobody will buy these machines without having first seen their utility demonstrated.

"Ditchers and sewerage apparatus might be introduced into the Prussian provinces, where the soil for the most part is sandy and no rocks would be encountered. Considerable irrigation is also carried on."



THE FRIEDRICHSBRUCKE, BERLIN.

THE STRENGTH OF MATERIALS.

A NEW edition has just been issued in England of a work that is everywhere regarded as the standard authority on the subject, "The Testing of Materials of Construction: A Text-Book for the Engineering Laboratory and a Collection of the Results of Experiments," by William Cawthorne Unwin, F. R. S. The first edition of this important work was issued ten years ago, but the book is one that appeals mainly to specialists, and not until the present time has the author been able to issue a new and revised edition. The reviews of the book that have appeared in a few of the English technical journals have been the occasion for gratuitous sneers at American building, which is assumed to give little attention to the scientific tests of the strength of materials or to test and then strain to the danger point. American architects and builders are not wholly free from reproach for insecure building, any more than those of other countries, but it is certain they have no more sins of this sort to answer for than their brethren across the seas. The condition of affairs in this country has made necessary the building of many structures that are intended to be temporary at best. Builders have been called upon, too, to confront many problems that were entirely new, where few lessons were to be gained from experience. The few cases of disaster have been due, not to ignorance, but to rascality, in the main, and this has been found in every country and in every age, since man first made his home of woven branches. Our huge buildings have stood enough of the test of time to show that they have been constructed according to proper principles. Materials have not been strained to the danger point, however, as one journal intimates, nor do the buildings "collapse under slight additional weight." On the contrary, they have been subjected to wholly unforeseen tests, to fire and flood, cyclones, and even earthquakes, in a few instances. And they have stood staunch and true.

"The Architect and Contract Reporter," of London, says in a review of Prof. Unwin's book: "It is evident that the subject of 'Testing of Materials' is one of those which architects and engineers leave to specialists. Although they might be desirous to be assured of the strength of the stone, brick, concrete and metals which are employed in the structures they design, yet they cannot spare the time or possess the apparatus required for experiments. An enthusiast like Tredgold can at all times contrive to gain knowledge about materials, although living in a state of poverty; but martyrs to science of his class are likely to be few. Besides, such experiments as he engaged in would not satisfy modern needs. They were inspired by an aim that differed from that of the earlier investigators of the *subject, for* Tredgold wished to be useful to practical men, while his pre*decessors* were more anxious to exhibit some phenomena of matter. Eaton

Hodgkinson was able to operate on larger specimens than Tredgold, for he had Fairbairn at his back, who allowed him to employ the appliances which were in the Manchester works, and constructed others specially for the testing. Yet when a novel structure like the Britannia Bridge was proposed, it was necessary to institute a costly series of experiments in order to determine anew problems of tensile and transverse strength of which solutions could be deduced to some extent from the information which was already in print. During the last half-century experimenting has not ceased, and yet, if we may judge by what is being done every day in America and Germany, it becomes evident that more reliance is placed on a special test by means of one of the latest varieties of machines than in all the recorded results which can be produced from books.

"In cases like the Britannia and the Forth Bridges, where novelty of construction is desirable, testing is indispensable. For the cloud-capped layers of offices which are being raised in America it is always wise to ascertain what weights are required to crush the materials that have to sustain the greatest load. It is also well to discover whether some new kind of material, natural or artificial, has as much strength as ordinary materials which resemble it. But at a time when parsimony inspires many of the arrangements for building, it is hardly desirable that materials should be strained under the warrant of science to a degree that approaches danger. Get a reasonable amount of work out of a steel or a timber joist, but do not make it a scientific marvel in order to exemplify how far it is possible to go without a collapse. That seems to be a not uncommon practice in America, for the love of risk which at one time gave interest to journeys in steamers is now seen in buildings and other structures, which occasionally collapse when a slight additional weight comes upon the materials. The desire for saving is so general in some classes of construction, if it were not for building acts and by-laws the loss of property and of life would occur more often than is now recorded in newspapers. The practices dignified by the title of 'economical building' are too often dangers to the State, although they are supposed to be sanctioned by science. The Tay Bridge, for instance, was the work of a mathematician, and was supposed to comply with the conditions which theory as taught in universieies demanded, but it was no more adapted to the needs of a material world than those lines which have length without breadth.

"What surprises may be devised in engineering nobody can foresee, and for the engineer experiments in testing must accordingly become suggestive. The fact that undoubted changes sometimes leave no outward or visible sign, only incites to further inquiries. For example, we are told by Professor Unwin that 'a bar subjected to so many repetitions of loading that it is known to be on the point of breaking, or a piece of a bar already broken in an endurance test, gives in the testing machine no indications that the strength or ductility has been altered.' That sort of anomaly will not be taken as an obstacle to research; new machines will be devised to deal with it, and observations with more powerful microscopes or other means will be employed to explain why there is such a variation from what appears to be an universal law. To the engineer, many of whose structures are subjected

to dynamic force, it is important not only to know that iron or steel can be fatigued, and becomes less capable of performing its allotted task, but it is well to have the knowledge verified and confirmed in several ways. Iron or steel as employed in buildings does not undergo the toil which is common in railway bridges, although if what is called the 'safe load' is much exceeded, as is too often the case, fatigue is as inevitable as in the case of girders over which locomotives pass several times in an hour. The architect has not, therefore, continual interest in the fracture of bars. He works on a small scale, and has not those 'perils which environ the man who builds with naught but iron.'

"But the architect can hardly fail to remember that at one time buildings were erected of a very complicated sort, and he must ask himself by what process was the strength of materials in novel forms determined. Was it by means of repeated failures? Viollet-le-Duc tells us: 'It was necessary to rebuild all the flying buttresses in the early Gothic monuments some years after their construction; and then men either contented themselves with raising the summit of these buttress-arches, or they doubled them by a second arch.' It is evident, however, that at an early period of Gothic they were able to realize not only the resistance which had to be offered by a mass of masonry, but the part which every course had to sustain. Sometimes they preferred small stones with thick mortar to large stones. As Viollet-le-Duc says, when they used soft stones for points of support height was given; hard stones were kept to be used for ties or lintels. He points out how 'a Burgundian architect in the twelfth century did not build at Dijon as at Tonnerre, for if we find in the same province the influence of the same school in the execution of the masonry, we remark considerable difference resulting from the nature of the stone employed. But as in each province there is one prevailing kind of material, the architects adopt a method of building in conformity with the nature of those materials. Bergundy, so rich in stone of a superior quality, furnishes us with the most proof of this fact.'

"The only machines and apparatus existing in Mediæval times which bore any resemblance to those now employed for testing materials were the appliances for torturing men in feudal dungeons, and it might be imagined it was from the operations on the human body that the pulling, twisting and compressing of materials in engineering laboratories were derived. The common sense of the builders inferred, from the evidence afforded by the examples of masonry they saw around them, principles of construction which could not be easily improved by the assistance of testing machines. In engineering structures of steel, or sometimes even of timber, it is possible to anticipate the work which has to be done, and experiments on specimens become, therefore, indications of what will occur. With masonry, on the contrary, preliminary trials are not of much use in revealing the future effects. Professor Unwin acknowledges this when he says: 'It is quite impossible in any actual structure to secure a simple condition of crushing stress. Settlement, imperfect bedding, unequal compressibility of different blocks, and other causes introduce unforeseen and incalculable straining *actions.' It is* well to bear these facts in mind, for of late years there are

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exaggerated notions abroad concerning the advantages which science can confer on architecture. As yet chemistry has not done much to encourage architects to devote their attention to it, and there is more likelihood of ensuring the erection of buildings that will endure from a study of ancient examples than from crushing large or small specimens of stone and cement. The pedant in the ancient comedy who expected people to judge of the character of his house from a single brick was not considered to be a wise man. But he is hardly as ridiculous as the young man who, from seeing a few bricks succumb beneath pressure, poses as a representative of a new school of architecture which, like an old-fashioned Adelphi farce, is to be based on the smashing of things.

"It is right, however, to have bricks and other materials smashed to pieces. At a time when science enables men to make worthless products appear to have the qualities which are most desirable, it is well to employ science as a detector. To know how a brick, a piece of stone or timber, or a part of a girder, will conduct itself when operated on by a testing machine, is desirable information for an architect. The result is not a guarantee that all the materials which are represented by a few victims taken at random are satisfactory; but there is, at least, the satisfaction of knowing that an effort was made to arrive at the truth. The tests, however, should be left to experts. Pupils would, of course, be glad to have occasional opportunities of discovering what the breaking weight of a building material is, but an ordinary office is not adapted for the efforts required to overcome cohesion. A trustworthy machine is, moreover, costly, and only in cases of large works is the expenditure on one to be recommended."

A VETERAN IN THE CEMENT BUSINESS.

MR. E. S. VAUGHAN, president of Moen's Asphaltic Cement Co., of No. 103 Maiden Lane, this month celebrates the forty-fourth anniversary of his connection with this company. Close identification with one business for such a length of time as this, passing the ordinary generation of man, is an extremely rare event in this country, although there may be many instances in the Old World, where business is conducted along more conservative lines. Mr. Vaughan's long connection with the manufacture of cement seemed to have so important a bearing upon the industries to which STONE is devoted, that a representative of the magazine called upon this gentleman to get his brief reminiscences of his business career.

Mr. Vaughan is still an active, energetic business man, giving few indications of the number of years that have passed over his head. He was

born on a farm in Washington County on Sept. 9, 1816, and spent his early years on farms in that and the adjoining county of Warren, in the usual experiences of a farmer's lad, varied with a few mercantile ventures. Mr. Vaughan came to New York in 1854. Shortly after that, in April, 1855, he became connected with the Moen's Asphaltic Cement Co.

The business was established in 1854 by Mr. A. R. Moen, who invented the process that is at the base of their system of cementing. Mr. Moen died in 1867, and Mr. Vaughan has for a number of years been the head, both nominal and active, of the business. The works are in South Brooklyn, where they were established in 1856. Asphalt had been little used at that time in any form, but the company began to employ it for the water-proofing of underground vaults, mainly for such as extend under the side-walks in front of business houses. There were a few cargoes of asphalt here, brought as a venture from the Island of Trinidad, which the company purchased. They bought it first in a crude state and refined it, but for many years past they have purchased the refined article. While the company still make use of asphalt, they have combined with it to a large extent, coal-tar-pitch. Mr. Vaughan, after looking through the records of the company, found that a few applications of the water-proofing system to cellars had been made as far back as 1856, but he said that at that time every one was skeptical of its efficacy. The public declared that cellars could not be water-proofed: it had been tried many times, but had failed. The company soon silenced all of these croakers, however, and proved that their system was all that was claimed for it. The water-proofing of vaults, which means simply keeping water from percolating from above, was a comparatively simple matter, but it was a far different and more difficult matter in cellars, where the effort was to prevent the water from coming up from below.

The company is now doing a class of work that was not attempted until comparatively recent years. The water-proofing process starts, in many instances, with the first work on the building. When the mason lays the foundation a damp course is put on, the water-proofing connects with this and is carried up on all sides as far as the walls are exposed to damp filling. The foundation is thus completely wrapped in a water-proof covering, so that no moisture can seep through the walls. This, of course, is even more important in dwelling than in business houses. The company is now also laying rock-asphalt floors from cellar to roof, and is making brick, tile, felt and gravel roofs.

Mr. Vaughan still gives active attention to the business, with all of the details of which he is thoroughly acquainted. He is a member of the Mechanics' and Traders' Exchange; of the Building Trades Club, and of the General Society of Mechanics' and Tradesmen. Mr. Vaughan is the president and treasurer of the company, and his son, Mr. J. W. Vaughan, is the secretary. Mr. Vaughan is a representative of the best type of the New York merchant, a country boy who early came to the metropolis and witnessed its growth and participated in its prosperity.

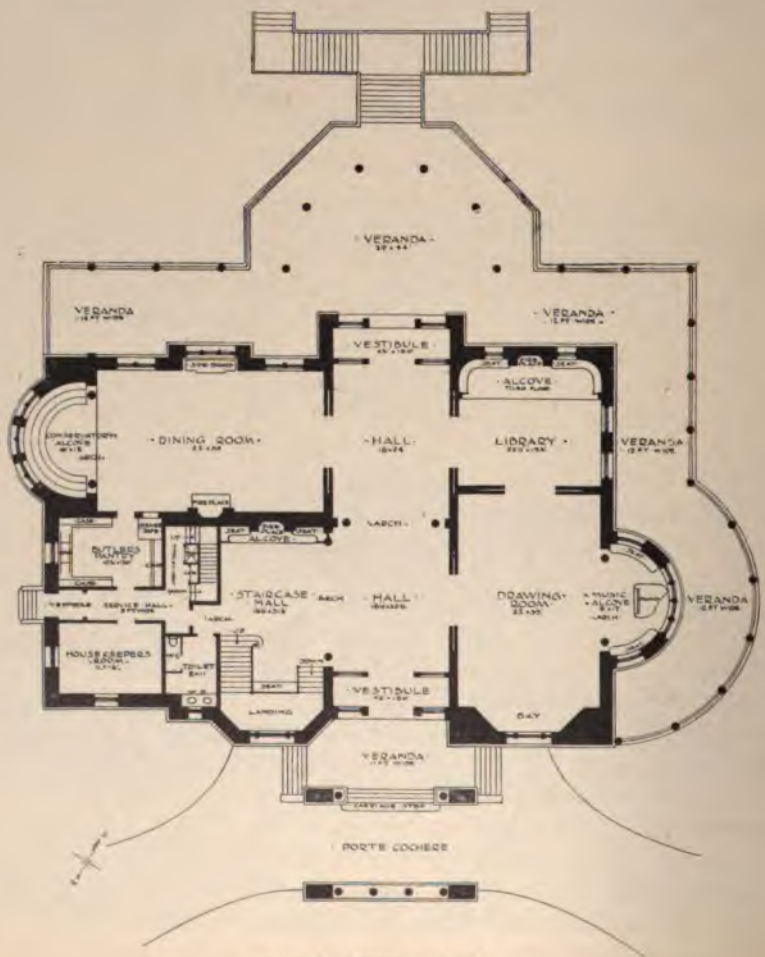
RIVER FRONT.

KING STREET FRONT.

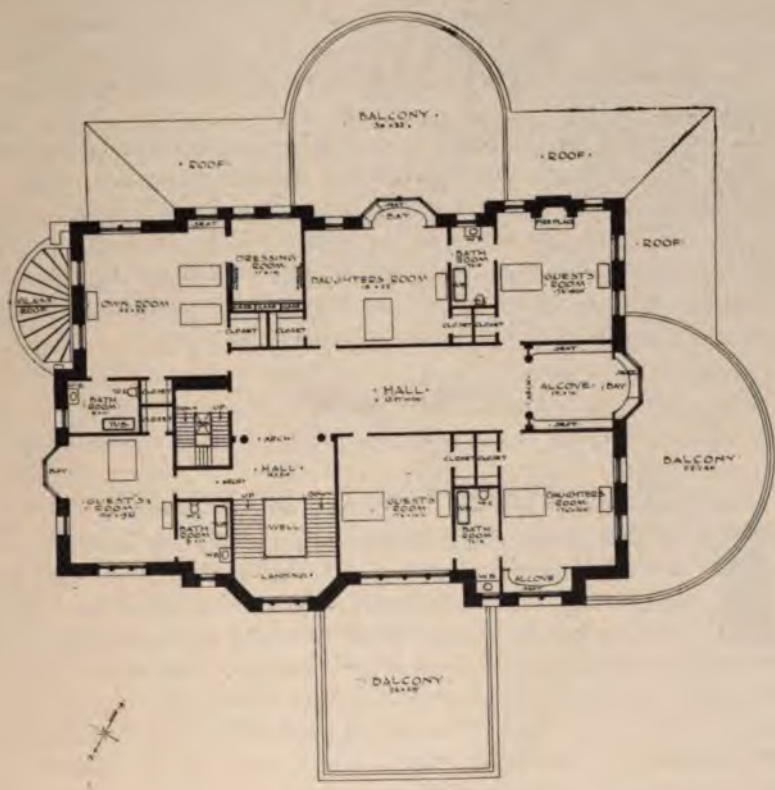
Residence of G. T. Fulford, Brockville, Ontario. A. W. Fuller, Architect.

A BEAUTIFUL MARBLE RESIDENCE.

STONE takes pleasure in presenting to its readers this month four illustrations of a magnificent marble residence shortly to be erected at Brockville, Ont., by G. T. Fulford, Esq. The illustrations represent two elevations and the plans of the first and second floors. Architect A. W. Fuller, of Albany, N. Y., who has designed many of the leading buildings in all parts of the country, prepared the plans for this striking mansion. The general style of architecture of Mr. Fulford's house is colonial, and the material from which it is to be built is Gouverneur marble. This of the light medium shade, and is very uniform in color. It retains its brightness for years, and is strong and durable. The Government test shows its strength to be 12,692 pounds per



PLAN OF FIRST FLOOR.



PLAN OF SECOND FLOOR.

square inch. The site is on the banks of the St. Lawrence, having a frontage of about 750 feet, with a gradual slope from the river up to the house, which will be distant from the river some ten hundred feet. The site is an imposing and ideal one, and could scarcely be improved.

The plans call for a veranda extending around two sides of the house, with a width ranging from twelve to twenty-nine feet. The hall, or salon, on the first floor, extends completely through the house, with a width of eighteen feet, and with a vestibule at either end. Connecting with this, by an arch, is the staircase hall, sixteen by thirty-one and a half feet, with an alcove fireplace. This hall connects by a narrow arch with the servants' hall and entrance at the side. Two particularly attractive features of the first floor are a conservatory alcove, with a glass roof, connected by an arch with the dining room, the latter being twenty-two by thirty-five feet in dimensions, and a music alcove with window seats, connected by an arch with the drawing room, which is the same size as the dining room. The drawing room also has a bay window. In the library is an alcove with tiled floor, a fireplace, and chimney seats.

On the second floor, the grand hall, thirteen feet in width, runs at right angles to the hall *below*. At one end is a large alcove, thirteen by sixteen

feet, entered through an arch, with a bay window and seats on three sides. The bedrooms, six in number, are all of large size, and each one has a spacious bathroom. Three large balconies, on three sides of the house, are built over the verandas below. Well arranged servants' quarters are on the third floor.

The stonework for the house is now being cut, and the actual building operations will be begun as soon as the weather permits. Most of the work is being done by the day under the supervision of John S. Mix, of Brockville. The interior finish of the house will be in keeping with the beautiful exterior. The woodwork will be of Flemish oak, mahogany and white enamel, with wood mantels. The roof will be shingled. Contracts for woodwork, plumbing and heating have not yet been let.

THE WORK FOR GOOD ROADS.

THERE is no branch of civic administration that should command a more united and enthusiastic support from all who are engaged in the stone industry than that of good road building. In much of the work the stone trade is directly interested, of course, as in the construction of macadam roads; but even where the highest ideal sought is a well-made dirt or gravel road, it behooves stone men to give their aid and encouragement. The most essential thing is the awakening of a general interest in the subject, and the sweeping out of existence of the sloughs of mud and quagmire that do duty as roads in many sections of the country. Unfortunately we in America have not yet learned the lesson of disregarding first cost, in matters of this kind, and building, as far as possible, for all time. The expenses of administration are large, the growth of communities is so rapid there must be constant erections of new public buildings, and it seems to the overburdened taxpayer that the easier plan is to make the ordinary dirt road do, even though the annual bill of repairs, added to the loss in traffic, would far more than meet the interest on bonds sufficient to pay for the construction of the best roads obtainable. The influence of Massachusetts and New Jersey, however, has been wholesome, and the vast body of bicyclers, who have organized and will use their votes to back their demands, ma be depended upon to give effective spread to the gospel of good roads.

In the Southern States it seems to be the general impression that dirt and gravel roads are good enough, owing to the absence of the disturbing effects of frost. Wholesome lessons could be learned from the experiences of Southern Continental Europe, where macadam roads are found to be one of the very best investments, even for purely agricultural communities.

The recent severe spell of rain, snow and mud, however, has set the farmers of North Carolina to talking about better roads. Many counties are eager to adopt the Mecklenburg system. About 1884 Mecklenburg County began to build macadam roads with convict labor. Since that time the work has gone on slowly but continuously, until now the country has 64 miles of

fine road. In constructing the 64 miles the county expended $162,772.80. The average cost per mile has been $2,543.33. This includes the cost of the bridges built on the roads that have been macadamized and the cost of the working outfit and machinery now owned by the county, which is approximately worth $6,000 or $8,000. The present county road tax in Mecklenburg County is 18 cents on the $100 taxable property. This raises nearly $20,000 each year. This fund is expended in working convicts and building the macadam roads. Each township, in addition to this tax, levies a special tax, usually 7 cents on the $100 worth of property. Some of the townships levy more than this. Last year the county commissioners supplemented the $20,000 to the extent of $13,000. Therefore nearly $34,000 was spent last year. And to-day the farmers of the county are clamoring for $200,000 worth of bonds in order to extend the roads to the limits of the county. They are eager to vote for the bonds, having seen the value of macadam roads. A bill has been introduced in the Legislature, now in session at Raleigh, to allow the county to vote on $100,000 worth of bonds. There is no objection to the bill, and before the Legislature adjourns it will become a law.

But even where the movement has not attained to this healthy stage, it is encouraging to find determined efforts for the betterment of dirt roads. This is the first step, and stone roads are bound to follow before long. An excellent plea for good roads, although it is based on the misconception that a dirt road is cheaper in the end for the South than macadam or Telford, was read by H. Harding, of Birmingham, before the Alabama Industrial and Scientific Society. Mr. Harding said:

"We claim to be a progressive people, but in some things we are very conservative. We are apt to cling to methods and systems that we have inherited and grown up under, our sense of their inconveniences being blunted by long usage. Especially has this been the case in regard to our highways. As our fathers made them, so we maintain them. But a spirit of unrest is beginning to manifest itself on this subject. It is gradually dawning upon us that our roads and the method of maintaining them, however well adapted to pioneer days, do not suit present conditions. A demand for better roads comes from many portions of the State, and a discussion by this society of the best method of obtaining them may elicit information or bring out suggestions that will be timely and valuable.

"In this paper our roads will be considered wholly from an industrial point of view, that is, as designed primarily for hauling and not for driving. A good road, then, would be one over which the wagons in common use could be hauled when loaded to their full capacity. Probably twelve bales of cotton, making, with the wagon, a gross weight of about 7,500 pounds, would be the limit of safety for ordinary wagons, and this will be assumed as the load for which the roads should be so improved that a four-horse team could haul it over all portions of them.

"A corresponding load of six bales for a two-horse wagon would give a gross weight of about 4,000 pounds, or 2,000 pounds to the horse.

"It is a prevalent opinion that a good road must necessarily be a macadamized road. This is generally true in the Northern States, where the ground freezes to a *depth of three* feet or more. A thaw leaves the ground soft to

the depth that it was frozen and, to guard against the consequent mud and the effects of frost upheaval, a thick macadam or Telford protection is needed. Here, where a freeze seldom extends more than an inch or two below the surface, the mud from a thaw is thin and, on a well drained road, quickly disappears, so that a protective coating is not essential.

"For hauling uses macadam roads are, with us, more of a luxury than a necessity. For, although on a level macadam in good condition a two-horse team can draw a gross load of 10,000 pounds, wagons would seldom be subjected to such strains even if able to resist them safely, for teams traveling on the macadam would usually have reached it from farm and neighborhood roads with loads limited by the conditions there existing. Hence the facilities offered by a macadam could not for the most part be fully utilized. But even if macadam roads were very desirable, and however desirable they may be, their cost is a bar to their general use. In the most favored localities the cost would hardly be less than $3,000 a mile, and since the public road mileage in the State is from 500 to 1,000 miles to the county, probably no county would be able or, at any rate, willing to incur the expense of macadamizing in a general system of road improvement. Suburban districts, where density of population would lighten the individual burden, may indulge in macadam roads; elsewhere throughout the State they would be classed among Mr. Ingalls' 'irridescent dreams.'

"We must then, generally, and for the present, rest content with dirt roads, and it is the object of this paper to suggest for discussion how and to what extent they may be improved without exceeding the ability or willingness of the people to meet the cost of such improvement.

"Our public roads require improvement in the three main features that determine their degree of excellence, viz., location, surface resistance and grade per cent., i. e., the rise in feet per 100 feet used in surmounting hills. These will be considered in order mentioned.

"As to location or alignment, it is enough to say that, at least for much traveled roads, it should be such as to give the shortest distance consistent with easy grades and the best ground for road construction. Zigzagging along section lines should be done away with. The length of the diagonal of a section is six-tenths of a mile less than the sum of two sides. To withhold this saving in distance from the public is virtually to lay an onerous tax upon it for the convenience of an individual.

"The road surface, to give the minimum resistance, should be hard and smooth, i. e., clear of ruts, rawed dust, loose stones or free sand. With dirt roads this ideal condition cannot be fully reached, and they cannot therefore be made absolutely good. But they can be made practically good, that is good enough generally to allow full loads to be hauled over any and all portions of them."

"The degree of excellence that can be attained in improving the surface of dirt roads and the facility with which this can be accomplished depends largely upon the nature of the soil. Generally speaking, any soil that can be packed when dry will make a good road as long as it can be kept dry or but slightly moist. A soil then is good or bad for road purposes in proportion to the thoroughness with which it may be kept free from saturation.

"Nearly all our soils become saturated after continued rains, and when traveled over in that condition become muddy, if not miry. On our roads this saturation, to a great extent, can be, and to have them good, must be prevented. The means for accomplishing this object are generally well known, but as they are also quite as generally neglected, or at least inadequately used, it may be well to call attention to them.

"The three essential preventives to saturation are crowning the surface, compacting the roadbed and thorough drainage. Crowning is needed to carry off the rainfall and prevent standing pools. Four inches for a ten-foot road is the crown recommended by the best authorities, but since, on a road of that width, the traveled track would be in the center, which would wear down, it would be better to make the crown originally six inches. On hills the crown slope must exceed the grade slope, that the rainfall may reach the ditches and not run down the road.

"Compacting the roadbed is required to reduce the porosity of the soil and make it incompressible under heavy loads. This compacting can be best accomplished, in fact, can only be satisfactorily accomplished, by the use of road rollers, and every county undertaking to improve its roads should have such implements in its road equipment. Expensive steam rollers are not necessary; two-ton horse rollers have been found quite efficacious, but requiring more rollings.

"It has been assumed in this paper that our roads should be so improved that the maximum load for a horse may reach 2,000 pounds. In the Atlanta experiments it was found that the resistance to traction on a level dirt road in good condition was 5 per cent. of the gross load. A horse of average strength can, according to Trautwine, exert during a day's work a mean traction force of 100 pounds at a gait of two and a half miles an hour. As 5 per cent. of 2,000 is 100, the assumed maximum load is in accordance with these data.

"In ascending hills the grade per cent. must be low enough to allow the load for a level to be hauled over them. In this case, in addition to the surface resistance (which may be termed the friction per cent.), that due to gravity—the grade per cent.—must be overcome, and this must be applied to the weight of the horse as well as to that of the load, since the horse in ascending has to lift his own weight. The grade per cent. for a given load and friction per cent. may be ascertained by the use of a simple formula:

"Let t equal the traction force in pounds.

"Let h equal the weight of the horse.

"Let l equal the weight of the gross load.

"Let g equal the grade per cent.

"Let f equal the friction per cent.

"Then $g = \frac{t-lf}{h+l}$ or in words:

"From the tractive force deduct the product of the load into the friction per cent. Divide the remainder by the combined weights of horse and load. The quotient will be the grade per cent.

"In applying this rule two facts must be taken into account; first, that

within the limits of one to three miles an hour, a horse's pulling power increases as his speed decreases, and, secondly, that a horse may for a few minutes double his normal traction, if allowed rest after this extra exertion. If, then, in pulling up a hill, the gait be reduced from two and one-half miles to one mile an hour, the normal traction will be increased from 100 pounds to 250 pounds. Doubling this amount as the result of brief extra effort, makes 500 pounds as the possible draft power obtainable.

"It was found at Atlanta that a team of four small mules was stalled with an indicated pull of 1,900 pounds or 475 pounds to the mule. For an average horse this might become 500 pounds, as calculated above, but for a conservative estimate 475 pounds may be taken as the maximum pulling power of a horse. The weight of the average horse is about 1,000 pounds.

"Taking the figures as above given, the grade with maximum draft would be, by the rule, 12½ per cent. for a dirt road in good condition, and for a gross load of 2,000 pounds per horse, but in establishing such a grade it would be necessary to allow for frequent level resting places ten feet to fifteen feet in length, because it requires much more power to start a loaded wagon than to keep it in motion, and if a team is stopped on a grade, where it is using its full strength, it could not start again. On a well kept macadam road, where the frictional resistance is 2 per cent., the full load for a horse would be 5,000 pounds, which, by the rule, would give a maximum grade of 6½ per cent. Therefore, in improving dirt roads where ultimate macadamization is contemplated, this grade per cent. should not be exceeded."

The question of good roads is being agitated in the Pennsylvania slate regions, where it would give a decided impetus to business. The Bethlehem "Times" has been carrying on a crusade for the improvement of the road between Bethlehem and Nazareth, and there is every prospect that the county officials will act in the matter.

The total distance between Bethlehem and Nazareth, from borough line to borough line, is 7 76-100 miles. According to the estimate of the engineer the cost of improvement would be $38,787.27, built as follows: 3 56-100 miles Telford, 12 inches thick by 14 feet wide, and balance of macadam 6 inches thick by 14 feet wide, with earth shoulder 3 feet on each side, making width between gutters 20 feet.

The "Times" says: "From Nazareth the road continues on up to Wind Gap, to Pen Argyl and Bangor, and to the extreme northeastern end of the county. With the exception of about a mile the other side of Nazareth, to Cherry Hill, this road has a good, firm foundation of natural slate rock, with sufficient drainage along the route to carry off the surplus water. If, therefore, the road is built to Nazareth, it would furnish a stretch of twenty-five miles of good hard road running diagonally across the county from Bethlehem township, through Lower and Upper Nazareth, Bushkill, Plainfield and Washington townships."

DESCRIPTION OF APPARATUS AND METHODS USED BY THE MASSACHUSETTS HIGHWAY COMMISSION IN INVESTIGATING THE PROPERTIES OF ROAD BUILDING STONE.

Early in the history of the State highway work the Massachusetts Highway Commission recognized the value of having certain tests made on the stones used in the construction of macadam roads, and with this in view, the Commission secured the services of Mr. L. W. Page, a geologist, who has also a considerable knowledge of mechanics, to conduct such experiments. The experimental work has been carried on in the Engineering Laboratory of Harvard University at Cambridge, Mass. The apparatus used has been provided by the University, the only expense to the Commission being for the services of employees who are engaged in carrying on the tests. The aim of these inquiries has been to determine the nature of the qualities which constitute fitness or unfitness of the different kinds of rocks for use in road making, the effects of diverse methods of treatment used in the process of construction, and the relative value of the bed rocks and gravels which are found in the several parts of the State.

The experiments which have proved most useful thus far are the abrasion and the cementation tests. The machines used in conducting these tests were designed by Mr. Page, under the direction of the Commission, the abrasion machine being modeled after the Deval machine, such as is used in similar tests at the National School of Roads and Bridges of France.

The apparatus for making the abrasion tests consists of a cast iron cylinder 20 c. m. (7.9 inches) in diameter and 34 c. m. (13.5 inches) in depth. At one end is an opening which can be closed with a tightly fitting iron cover. The cylinder is mounted on an axle at an angle of 30° with the axis of the cylinder, and is supported on an iron frame. At one end of the axle is a pulley wheel, by which the cylinder is revolved; at the other is an instrument which records its revolutions.

The stones employed for making the abrasion tests with the Deval machine are of such sizes as will pass through a screen with a 2½ inch mesh, and not through a screen with a half inch mesh. In making a test, five kilogrammes (11 pounds) of the stone, previously cleansed, are placed in the cylinder; the air-tight cover is then screwed on, and the cylinder rotated at the rate of 2,000 revolutions per hour. A revolution counter attached to the shaft is frequently consulted, and permits the control of the regularity of the machine. The rotation of the cylinder throws the fragments of stone from one end of the cylinder to the other, twice in each revolution, and causes them to grind against one another and against the walls of the cylinder. At the end of five hours, or 10,000 revolutions, the machine is stopped, the cylinder opened and the contents emptied into a basin. The cylinder and the cover are carefully washed, and the water used is poured into a basin. Each stone is then washed and brushed under the water, and is thus cleansed from the adhering dust, which remains in the water as a sediment. After it is dry, the

detritus is emptied into an automatic sieve which separates that below 16 c. m. (1-16 of an inch) from that above. The per cent. of the .16 c. m. dust may be taken as a coefficient of wear, or the coefficient adopted by the French School of Roads and Bridges may be adopted by the formula:

$$\text{Coefficient of wear} = 20. \times \frac{20}{w} = \frac{400}{w}$$

where w is the weight in grammes of the detritus less than .16 c. m. (1-16 of an inch) in diameter obtained per kilogramme of stone.

Great care is taken to make the tests of all specimens under precisely similar conditions, so that all results are comparable. The results of about 170 tests with the Deval machine can be seen in the 1898 report of the Massachusetts Highway Commission, pages 63 to 68. The results of some of the tests on the more common rocks are given below:

Kind of stone.	Highest Result. *Coeff. of wear.	Highest Result. Per cent. of wear.	Lowest Result. Coeff. of wear.	Lowest Result. Per cent. of wear.
Diabase (Trap)	30.40	1.31	9.28	4.31
Granite	21.16	1.90	8.41	4.76
Felsite	19.91	2.01	12.30	3.25
Gneiss	23.02	1.73	5.01	7.98
Limestone	17.20	2.33	6.31	6.34
Schist	12.52	3.19	4.87	8.20
Quartze	20.34	1.97	9.07	4.41
Field stone (erratics)	19.19	2.08	5.43	7.30

The Commission is considering the purchase of a new machine, consisting of four cylinders attached to one shaft, by means of which four tests may be made simultaneously. A design for such a machine is shown. The machine now in use cost about fifty dollars, and it is expected that the new machine may be built at a cost not greatly in excess of that sum.

The machine used for testing the cementing value of stone consists of a one kilogramme (2.2 pound) hammer, arranged like the hammer of a pile driver on two vertical guides. The hammer works automatically, and can be dropped from any desired height upon a plunger under which the briquette to be tested is placed. This plunger is also held in two guides, and attached to it is a lever, pivoted at one-sixth of its length from the plunger, and carrying a pencil at its free end. The pencil has a vertical parallel movement five times as great as that of the plunger, and its movement is registered on a drum against which the pencil presses. The drum rotates through a small angle at each stroke of the hammer; thus an automatic diagram is taken of the behavior of the briquette throughout the whole test. The point brought out by this machine is the fact that, when the hammer falls on the plunger, if the material beneath it can withstand the blow, the plunger recovers from the downward thrust given by the hammer; if not, the plunger stays at the point to which it is driven. In this way the number of blows previous to the critical blow, which destroys the bond of cementation, are accurately recorded on the drum.

The present machine used for this work is 67 c. m. (two feet) square and 274 c. m. (nine feet) high. A new machine is now under construction, which will be less than half the height of the old one, the difference in height

*On the French system.

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being due to a simpler and more efficient gearing. This machine was designed and built at the Highway Commission laboratory. It would probably cost between $150 and $200 to make one like it.

The briquettes for the cementation test are made by reducing the stone to a dust that will pass through a sieve of .25 m. m. (1-100 of an inch) mesh. The powder is then put into a slightly tapered steel die of circular section, about 30 m. m. (1.33 inches) in diameter and 25 m. m. (.98 inches) in height, mixed with water and subjected to a pressure of 2,000 kilogrammes (4,400 pounds). The resulting briquette is then put aside for at least one week, so that it may thoroughly dry.

A machine which is almost inseparable from the two which have just been described is the automatic screen. This machine consists of a drum made of brass wire netting, of the following sizes: .13 c. m. (1-20 of an inch),

ABRADING MACHINE.

.064 c. m. (1-40 of an inch), .042 c. m. (1.60 of an inch), .031 c. m. (1-80 of an inch), .025 c. m. (1-100 of an inch). It is mounted on bearings at a slight angle with the horizontal. Into the upper end of the drum the unscreened dust is automatically fed from a hopper while the drum is rotating, and is thus sifted into the several sizes. The upper end of the drum rests on wheel bearings, and on this bearing surface there are several ridges which cause the drum to jump when the wheels strike them. This last device is necessary to keep the finer meshes of the screen from getting clogged with dust. The rapidity with which dust can be sifted with a machine of this sort, and its cleanliness, makes its use almost necessary.

The screen was made at odd times at the laboratory, and it is therefore impossible to estimate its cost, which, however, was small. It is about 134 c. m. (four feet) long, 67 c. m. (two feet) high, and 36 c. m. (14 inches) wide.

A small Gates crusher is frequently used for breaking stone into small sizes. It is particularly useful, though not at all necessary, in the processes of reducing stone into dust. This is also done by breaking the stone into small fragments, and then putting them into the Deval machine with a piece of metal of circular section and flat ends, weighing about 10 pounds, and allowing the machine to run a sufficient length of time.

There are two testing machines belonging to the University which are also used when occasion demands. One is a Riehle, with a capacity of 200,000 pounds; the other is an Olson, with a capacity of 60,000 pounds. The Riehle is better adapted for heavy work, such as testing paving stones and vitrified brick; the Olson for *making* stone dust briquettes and all light work.

The power used in operating all of these machines, except the Riehle and Olson machines, is furnished by the University, and consists of a 3 h. p. steam engine and a 3½ h. p. gas engine. The steam engine is used in winter and the gas engine in summer.

In order to determine the nature of the samples sent to the laboratory, it is in most cases necessary to make thin sections of the rock specimens for microscopic examination. This work has been done in the petrographic laboratory of the University, which is supplied with a diamond saw, a corundum saw and numerous grinding discs run by an electric motor. Here also are sawed and shaped the cubes of stone used in the impact and compression tests.

As the greater portion of the time of the employees in the laboratory has been devoted to the field work and the abrasion tests, the work of determining the cementing values of the fines of the stone has been somewhat neglected, and the results obtained from such tests thus far do not warrant their publication at the present time. It is hoped that before long work may be resumed on these tests.

The Commission has also in view the study of the cementing properties of the various kinds of gravel found in the State. It is hoped that an effective size of gravel may be established, and the best method of holding the gravel in place on the roads by some binding material which will not only stand the wear of traffic, but which will also resist the action of the elements and not rut when the frost comes out of the ground in the spring.

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Massachusetts Highway Commission.

GOVERNMENT TESTS FOR CEMENT.

THE Russian Government has recently drawn up a series of tests and conditions enforced in the selection of Portland cement. These are as follows:

1. Casks of cement furnished for building purposes are to be of uniform weight, say, 180 kilos gross and 170 kilos net. That upon each cask be plainly stamped the trade mark of the factory and the weight, both gross and net. That the loss of cement from spilling and for difference in filling casks should not exceed 2 per cent.

2. Cement intended for building purposes should always be of the slow-setting kind, for such cements are more easily worked, are more reliable and possess greater power of adhesion. Cement is considered slow setting when it does not set before the expiration of three-fourths of an hour after mixing the paste. Portland cement hardens more slowly as the temperature falls; therefore, to avoid misunderstandings, all tests should be conducted in a room *having a uniform* temperature of 15 to 18 deg. Centigrade, and only water of

about the same temperature should be used. During the process of setting slow-hardening cements generate but little heat, while with the quick setting a considerable rise of temperature may ensue. To ascertain the time of setting, a cake of pure cement, prepared upon a glass plate, is taken. After the lapse of the above-mentioned time this cake must have acquired such a degree of hardness that the passage of a finger-nail gently grating it should leave no trace and no water ooze out when the surface of the cake is lightly rubbed.

3. A cement cake prepared upon a glass plate and immersed in water some time after setting should, after remaining under water twenty-eight days, show no cracks or warping on its edge.

4. Portland cement must be milled into as fine a powder as possible. After passing through a sieve of 900 openings to the square centimetre there should in no case remain upon the sieve a residue exceeding 20 per cent.

5. The adhesive power of Portland cement is determined by submitting to tests of rupture a mixture of cement and sand, seven and twenty-eight days after making the mortar, and also the pure cement after seven days. The tests must all be made with the same apparatus, with samples of similar section, in an identical manner. For normal tests normal sand is employed, prepared from natural quartz sand, which is passed through a series of sieves and washed. The section of samples at the point submitted to rupture must be 5 square centimeters. In making samples, all their component parts must be taken by weight.

6. A mixture of one part of cement to three of normal sand twenty-eight days after setting must bear, as its minimum power of resistance to rupture, a strain of 8 kilograms to the square centimetre. Normal sand used in massing samples is prepared thus: A quantity of natural sand is passed through sieves of 64, 121 and 225 meshes to the square centimetre. Next, the portion which shall have remained upon the sieve of 64 meshes, and that passed through the sieve of 225 meshes, are thrown away, and the sand remaining on sieves of 121 and 225 meshes is mixed in equal parts; this mixture constitutes normal sand. To make cement paste or mortar, water is added in the proportion of 50 per cent. by weight of pure cement, or 12½ per cent. by weight of the dry mixture of cement and sand. This rule is to be applied if the manufacturer whose cement is being tested does beforehand state what proportion of water is best used with his cement. To attain all possible uniformity of quality, in cases where cement of the same brand is received in several lots, tests of pure cement are made.

In choosing cement for construction preference is given to that factory whose cement, all other qualities being equal, gives the greatest resistance to rupture after seven days tested pure. Pure cement after seven days must, when tested by rupture, bear a strain of no less than 21 to 25 kilograms on the square centimetre.

In preparing samples out of pure cement, water in proportion of one-third of the weight of cement is added, *i. e.*, when the process by absorption is used. Samples intended for testing must remain exposed to the open air during the first twenty-four hours after they are made, and then be kept in water till the moment of being tested. At each stage (seven and twenty-

eight days) of the experiment, ten briquettes must be broken when testing cement of an unknown firm or brand for the first time; for cement of a known brand at least five briquettes are necessary. When the normality of a cement is determined in a laboratory then simultaneously with the test after twenty-eight days, a test of the mortar after seven days must also be made, and the ratio of the two determined. It is necessary to know this ratio when making quick control tests. Mortar consisting of one part cement and three parts of normal sand must have a tensile strength after twenty-eight days of 8 kilograms on the square centimetre, or, after seven days, of not less than 5 kilograms to the square centimetre.

7. All the tests enumerated in the preceding rules determine the normality of a cement of a given brand. For cement of a known brand, in order to save time (especially when rests are necessary at the location of constructions), control tests are allowed to determine (*a*) the time of setting; (*b*) the property of briquettes made from pure cement to remain free from cracks and warping during seven days; (*c*) the fineness of the grain; (*d*) the resistance to rupture after seven days of pure cements and mixtures with sand. The resistance of a mortar composed of 1 part of cement to 3 parts of normal sand, seven days after being mixed, must in no case be less than 6 kilograms per square centimetre. Should the cement respond to all requirements from *a* to *d*, excepting *d*, then the tests may be adjourned for twenty-eight days, when the cement must undergo all the tests provided for in rule 6.

PRACTICAL STONE-CUTTING—XVI.

IN the construction of the wall we have the choice of two methods: Firstly, constructing it of solid stone, that is, of stones which go entirely through the wall, each stone containing two clean surfaces, one concave, the other convex; or, secondly, of stones 4 or 5 inches in depth with one clean face only, concave or convex, as the case may be according to the desired position of the stone at either face of the wall, the space between the stones being filled in with brick or rough stone. Of course, where good work is desired the former method is the one adapted for the purpose, but when economy has to be considered, then the second method may be employed, as it requires a less quantity of rough stock than that of the first method. However, it makes little difference as far as regards the projection of the moulds which of the methods may be employed in the construction of the wall, as the one method of development may be made use of to project the face moulds as required in either construction. We shall therefore assume the first mentioned to be the one employed.

After the stones may have been worked to their required cylindrical shape, that is, the concave and convex faces worked to the direction as given *by the bed moulds* for the stones in question, two face moulds are required

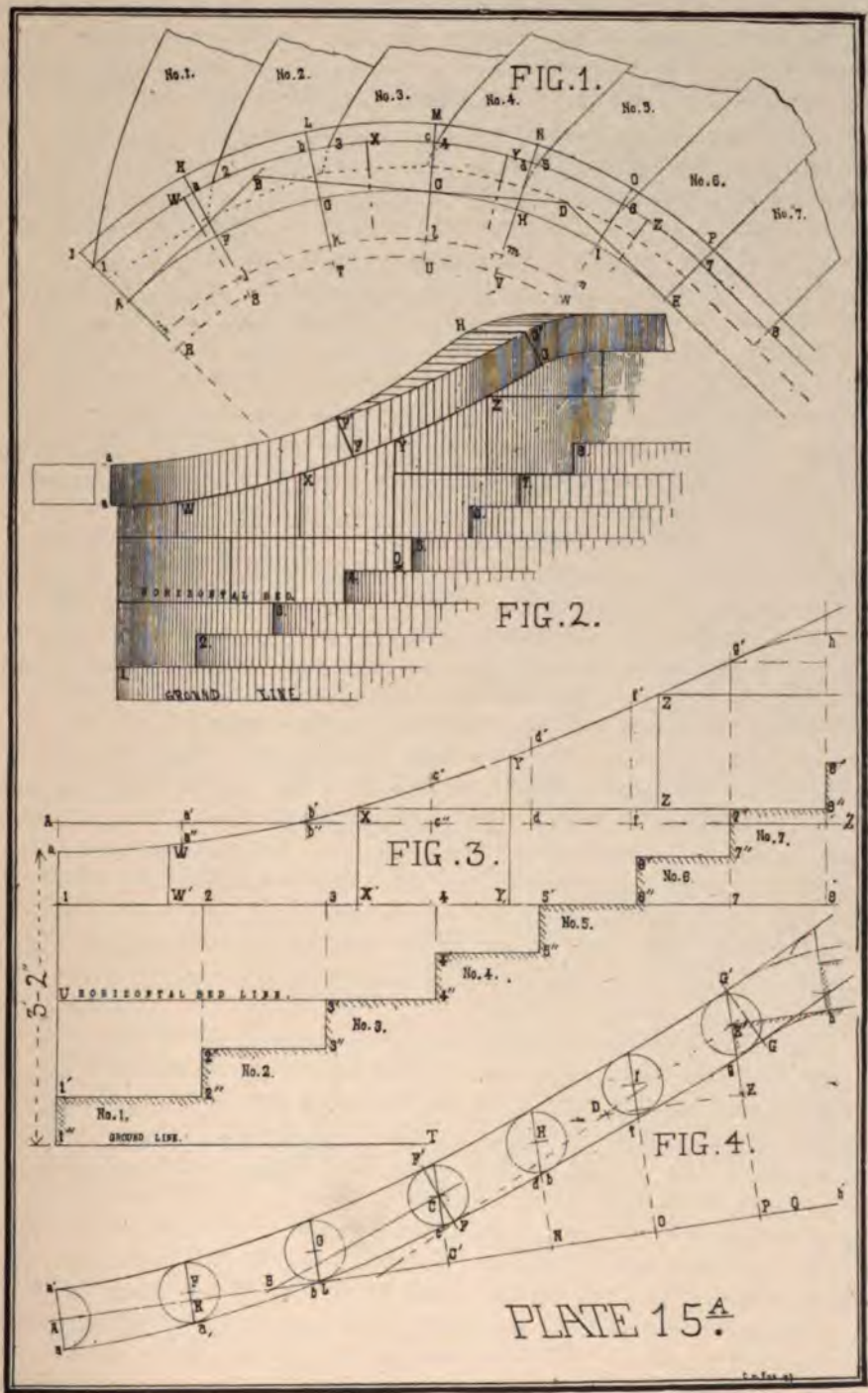
FIG.1.
No.1.
No.2.
No.3.
No.4.
No.5.
No.6.
No.7.
FIG.2.
HORIZONTAL BED.
GROUND LINE.
FIG.3.
No.7.
No.6.
No.5.
No.4.
No.3.
No.2.
No.1.
HORIZONTAL BED LINE.
GROUND LINE.
FIG.4.
PLATE 15A.

to give the proper direction in which to form the upper twisted surface, forming the top beds, corresponding to that shown in a-W-X, etc., of Fig. 2; one set will apply at the concave, the other to the convex faces of the stones. When, as in the example here presented, the projection of the coping beyond or over the face of the wall does not exceed 3 or 4 inches, the cutting line as required at the moulds may be readily developed by making use of the face moulds as those shown in Fig. 4, which are required to form the top and under lines at the convex face of the coping; when the projection of the coping is greater than that mentioned above, it will be better to develop a new set of moulds in the manner to be explained below.

Firstly: To develop the moulds as required at the convex face, making use of those shown in Fig. 4, to give the height, etc. In Fig. 3, set off A-a′-b′, etc., respectively equal to 1-a-b, etc., as given at the convex face line of the plan Fig 1. Then square with A-Z, draw a′-a″, b′-b″, c′-c″, etc., set off the length of these equal respectively to A-a, K-a_1, L-B, etc., of Fig. 4; through the points thus obtained trace a curve which will give the cutting line of the top bed as required at the convex face. Now set off a-1″ equal to 3′-2″, the height from the ground line 1″-T of the bottom bed of the coping (see plate 15), and draw 1″-T. Now set off 1′-2″, 2′-3″, 3′-4″, etc., equal respectively to 1-2, 2-3, 3-4, etc., of Fig. 1. Then making 1″-1′, 2″-2′, 3″-3′, equal to 6¼ inches, the rise of the steps, the lines at which the steps meet the face of the wall may be determined, and if (as they should be) the steps are "housed" in the wall the direction at which to "check" out the ashlar in order to receive the steps may be obtained. Now setting off the vertical height of the ashlar as shown in 1-U, etc., and drawing the parallels U-3′, 1-6″, etc., with A-Z, the horizontal bed lines may be obtained. Then as shown in W′-W, X′-X, etc., square up the projections of the vertical joints, noticing that they be drawn to "break joint" with the lower course; this will complete the moulds as required at the convex face. In a similar manner setting off the lengths as given in i-j-k, etc., of the concave face lin of the plan, Fig. 1, and making use of the moulds which may have been developed for the concave face of the coping, in the manner in which those of Fig. 4 have been made use of, the moulds as required at the concave face of the wall may be very readily developed.

Now, let us assume the projection of the coping, 1-J of Fig. 1, to be greater than that above mentioned, precluding the use of the development already made, as in Fig. 4. In the manner explained for the like operation in Fig. 3, set off A-a′, a′-b′, b′-c″, etc., equal to the length of the corresponding points of Fig. 1, and at each point erect verticals corresponding to those shown in K-F, L-G, etc., of Fig. 4; then, in the manner shown in Fig. 4, set off K-F, L-G, etc., equal respectively to F′-F, G′-G, etc., of Fig. 2, Plate 15. Now with F-G-C, etc., as centers and the half thickness of the coping as the radius, draw arcs as shown in Fig. 4. A line being drawn to touch the arcs will give the cutting line of the top bed of the ashlar corresponding to that given in a-a″-b″-c′, etc., of Fig. 3. Then in the manner described above may the drawing be completed. A similar operation will be *required in* order to develop the face moulds as required at the concave *face.*

C. H. Fox.

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GREAT BRITAIN'S MINERAL PRODUCTION.

The statistics regarding the production of minerals in Great Britain for the year 1898 has been published. The year is reported to have been one of prosperity, but the number of instances of decreased production over 1897 is greater than the increase.

The production of mines which come under the Metalliferous Mines Act —which includes all the mines not falling under the coal mines class—is given in the following table:

	1897.	1898.	Changes.	
Alum clay (Bauxite)	13,327	12,402	D.	925
Arsenic	4,165	3,896	D.	269
Arsenical pyrites	12,434	13,212	I.	778
Barytes	21,723	21,175	D.	548
Calc spar	4,066	3,230	D.	836
Chalk	2,211	1,878	D.	333
Clay and shale	93,656	86,641	D.	7,015
Copper ore and precipitate	7,352	6,740	D.	612
Flint and chert	2,163	2,313	I.	150
Fluorspar	257	56	D.	101
Gold ore	4,517	703	D.	3,814
Gypsum	117,051	134,195	I.	17,144
Igneous rocks, other than granite	82,525	99,440	I.	16,915
Iron ore	2,216,772	2,167,100	D.	49,672
Iron pyrites	2,038	2,584	I.	546
Lead ore	35,082	32,679	D.	2,403
Limestone	522,576	552,395	I.	29,819
Manganese ore	599	196	D.	403
Nickel ore	300	...	D.	300
Ocher, Umber, etc.	2,759	2,835	I.	76
Rock salt	182,078	182,770	I.	692
Sand	4,321	31,130	I.	26,809
Sandstone	246,460	244,306	D.	2,154
Slate	179,808	180,082	I.	274
Soapstone	28	...	D.	28
Tin ore	6,215	7,951	I.	1,736
Uranium ore	30	26	D.	4
Wolfram	125	324	I.	199
Zinc ore	19,278	23,553	I.	4,275

The total number of persons employed in and at mines of all classes in 1898 was 741,125, against 728,713 in the previous year.

Comment on Timely Topics

THE BUSINESS AND THE BUILDING OUTLOOK

THE general business conditions of the country continue to show a remarkable development. Testimony to this fact comes from every source. The Clearing House returns grow in the most amazing way, and all of the records for single days, for weeks, and for months seem to be broken. During one week in March, for instance, the payments through the principal Clearing Houses were seventy-eight and two-tenths per cent. larger than last year, and eighty and three-tenths per cent. larger than in 1892. The demand for staples is so strong that many manufacturers report an inability to fill their orders. Wages are being raised generally, not a day going by without the report of an increase in some new field or new industry.

Mr. T. Lloyd, editor of the "Statist," a famous British financial journal, as late as December 31, in a careful review of the business situation in America, reached the conclusion that while the outlook was good, business could not be said to have improved generally so long as wages were not advancing and manufacturers were not receiving orders for products ahead. Within two months, however, conditions have changed so greatly that Mr. Lloyd himself has been compelled to revise his conclusions. Notable advances have been made in the iron and steel trades, in tin plate, in cotton goods, and, in fact, in almost all of the great staples. As far as wages are concerned, instructive lessons may be drawn from a Labor Bulletin just issued by the Commonwealth of Massachusetts:

Comparisons are made for the city of Boston as to wages paid in the years 1870 and 1898, and also for the average of wages paid by eleven other cities of the United States. In 1870 the average pay of blacksmiths was $2.48, in 1898 $2.43½; blacksmith helpers in 1870 $1.40¼, in 1898 $1.52¼; boilermakers in 1870 $2.32, in 1898 $2.56; boilermakers' helpers in 1870 $1.41, in 1898 $1.53; bricklayers in 1870 $3.15, in 1898 $3.51; cabinetmakers in 1870 $2.14, in 1898 $2.29; carpenters in 1870 $2.36, in 1898 $2.52; compositors in 1870 $2.52, in 1898 $2.81; hod-carriers in 1870 $1.75, in 1898 $2; iron molders in 1870 $2.60, in 1898 $2.60; machinists in 1870 $2.30, in 1898 $2.41; painters in 1870 $2.22, in 1898 $2.60; plumbers in 1870 $2.74, in 1898 $3.15.

The growth of our foreign trade is almost startling, and, in fact, has *produced* a feeling of bitterness in the foreign countries that are our keenest

rivals in the manufacturing line. Count von Posadowsky, Secretary of State for the Interior, has drawn attention in the German Reichstag to the growth of American trade with Germany. The American exports to Germany in 1890 were to the value of only $86,000,000, while in 1898 they had increased to $155,000,000. On the contrary, American imports from Germany in 1893 were of the value of $99,000,000, and in 1897 had grown only to $111,000,000. The newspapers have been full of evidences of British chagrin at the general invasion of American machinery in Great Britain and her colonies. Armor plates for the British Navy are being planed by American machinery and American lathes are used to manufacture British bicycles. Every one is familiar with the comment that was caused by British orders for American locomotives. Lord Cromer, the British Minister, in his annual report on the finances and condition of Egypt and the Soudan, explains that an English firm offered to deliver the Atbara bridge, about which so much has been said, in six months and a half and at a cost of £10,490, while an American firm undertook to deliver it in forty-two days at a cost of £6,500. The American firm consequently got the contract. The ability of American houses to deliver goods in shorter time than their British rivals does not mean, as Mr. Lloyd seemed to think in his first article in the "Statist," that our manufactories are idle, but that our facilities for work are much better. Aside from this, labor troubles in England have done much to cripple British manufacturers.

The building trades are always particularly sensitive to general business conditions. Without any reports upon which to base conclusions, it would be safe to predict, therefore, that this year would bring unexampled opportunities to all the building industries. Reports from every source, however, confirm such predictions. Correspondents of STONE, even in small, out-of-the-way towns where a renewal of business activity is slow to make itself felt, write that the building outlook is most promising and that many contracts have already been let or are in preparation. Architects, builders and dealers in building supplies, confess to a confident feeling that the coming season will be one of the most profitable for many years. Vast sums have been appropriated for public buildings, and when there is added to this the large amount of private capital that will be invested in building operations, it will be seen that an enormous aggregate is in sight. All of this means that employment will be given to a great number of men at good wages, and this will help to stimulate the general prosperity. The strikes that were started among the stone cutters in several sections have been called off and arbitration will probably give a peaceful settlement. With so much work actually in sight there is no question but that employer and workmen will be able to come together in perfectly harmonious relations.

THE REAL DANGER IN TRUSTS

THE comments of the newspapers of the country in general upon the subject of trusts, dictated by their idividual attitude toward trusts and combinations, is apt to mislead the public as to the real gravity of the situation. One large section of the press is rabid on the entire question of trusts and sees merely an excuse for renewed raving in every new combination that is effected. The other section is optimistic. It believes that trusts are all right, except in the case of a few instances of palpable abuse, and it treats the criticisms of the opponents as a fair subject for jocosity. The real truth is to be found between these two attitudes. There are many industries which are natural monopolies, and trusts in these instances simply serve for economy of production and distribution, with an attendant lowering of prices. In every instance the public has reaped the benefit from such combinations, despite minor abuses and petty tyrannies. We have not such a poor opinion of American character and government as to believe that trusts will ever prove a menace to a free people. The danger that we apprehend is quite in another line. Americans are apt to be carried away by clever and promising schemes, and in no way have they shown this tendency to a more marked degree than in the present craze for forming combinations. Industries that depend entirely for their existence upon free rivalry, have been brought into incongruous association under the magic name of "trust," have been largely over-capitalized and expect to do a thriving business on watered stock. If there is anything that will put a check to the present unexampled season of prosperity it is this combination making. There has been a striking instance of this evil that may be ahead in a marked disturbance, amounting almost to a panic, in the stock markets of the country on April 7. The sole cause of this "slump" in the market, as every one knows, was a discrimination against industrial stocks by the banks. The reason for this action is not difficult to understand. Many stocks have obtained a fictitious value due to what was believed to be their prospective earning power under the combination system, and many are working on a capital that is more than half water. Of course the solid stocks that are honestly dividend paying had to suffer with those of the wildcat nature, and every other line of stocks was more or less affected in sympathy with the industrials. There was bound to be a quick reaction because of the general business condition, but there will always remain the element of danger until the combination schemers are kept within bounds.

Still another thing that makes the thoughtful anxious is the danger of over-production as the result of combinations. Of course the true province of *a trust should* be to cut off waste and restrict production to the actual con*sumption,* but where the time is not ripe for a combination or where all the

different elements of the industry cannot be gathered together, the danger of over-production is greater than in ordinary business competition. A striking instance of what may be expected in one industry that has recently fallen into the hands of the trust makers is given by a statistician who has mare a careful study of the cement industry. He has found that the estimated production of Portland cement by the mills now in existence and those to be ready for operation in a few months, amounts to the astounding total of 8,479,000 barrels for 1899. As the total production for 1898 was only 3,996,000 barrels, it will be seen that the very respectable increase of 4,483,000 barrels remain to be taken care of. If this can be absorbed by the increase of building and the growth of our exports, the country is to be congratulated. But it would seem by every consideration as if the time had come to cry a halt to trust promoters.

The Slate Trade

The Slate Industry of the World.

"The Engineering and Mining Journal," of March 25, has an article with the above title. The article gives the following table, showing the estimated production of slate in the world during the past year:

	1898.
Belgium	$350,000
Canada	40,791
France	3,800 000
Germany	16,000
India	14 000
United Kingdom	8,750,000
United States	3,625.000
All other	50 000
Totals	$16,645,791

These figures are to be compared with a total of $12,834.605, in 1896, and of $15.203,-385 in 1897.

In the United Kingdom the largest slate producing region is North Wales. Other districts of any importance are Westmoreland and Cumberland. Quarries have also been worked in Scotland, the Isle of Man and Ireland. The United Kingdom has the oldest slate quarries in the world. The production has steadily increased since the settlement of labor difficulties, and it is estimated that 1898 showed a total output of $8,750,000 worth of all kinds of slate. In 1897 the production of slate at the mines and quarries amounted to 609,194 long tons, valued at $8,016,939, as against 586,-933 tons, valued at $6,691,280, in 1896. This country has been making some heavy importations of roofing slate from the United States, and some of this slate has been re-exported, particularly to the continent of Europe.

In France the largest production of slate comes from the departments of Maine-et-Loire and the Ardennes. The most important quarries are the Trelaze and St. Barthelemy, in the Maine-et-Loire; the *Funæ and Rimony*, in the Ardennes. There are also quarries in Savoy and the Hautes-Pyrenees. The total value of the output in 1898 is estimated at $3 800,000, which compares with $3,506,142 in 1897 and $3,058,135 in 1896. The production in 1897 consisted of 674,000 m. (310,820 metric tons) of roofing slate, valued at $3,476,112, as against 641,000 m. (283,352 metric tons), valued at $3,028,373, in 1896; also 1,143 tons slabs, etc., valued at $30,030, against 1,148 tons, valued at $29,762, in 1896. There were also produced in 1897 31,067 metric tons of schist, used locally for roofing, valued at $19,812 as against 21,795 tons, valued at $14,111, in 1896.

Belgium has increased its production to about $350,000 in 1898, which is $27,652 more than 1897, and $80,500 over 1896. This slate came chiefly from Luxembourg and Namur, and was largely used for roofing.

Germany produces a small quantity of roofing slate, particularly in Bavaria. The total value in 1898 is estimated at $16,000, which compares with about $15,000 in 1897 and $14,252 in 1896. This country depends upon Great Britain for its supply of slate, although in recent years the United States has made some shipments.

India produces a slate that is usually black in color, and rather hard to split into thin sheets. Quarries have been worked at several places, particularly in Rajputana. The output has been irregular, varying from 10,936 tons, valued at $4,429, in 1894, to 59,215 tons, valued at $15,508, in 1895. A year later the production fell to 22,125 tons, valued at $9,624, but in 1897 it rose again to 26,169 tons, valued at $12,-931; while in 1898 it is estimated that $14,-000 worth of slate was turned out. This slate is used for building, flagging and masonry work.

In Australasia the colony of Victoria produces a little slate, but it is believed the industry will receive more attention hereafter. The imports of slate into the dif-

ferent colonies during recent years have grown, particularly from the United States.

Canada has not worked its slate quarries regularly, and since 1893 the output has decreased. The principal work done in exploiting the slate resources of the country in recent years was at the old quarries in Richmond County, Quebec. There are also quarries in British Columbia and Nova Scotia, where black, red and green slates are found. The total production of slate in Canada in 1898 was valued at $40,791, which compares with $42,800 in 1897 and $53,370 in 1896. This country has been exporting slate in late years, but the amount is small. The imports during the last two or three years amounted to something over $20,000, consisting of roofing slate, school slates and mill stock.

The United States slate industry has received most attention in the States of Pennsylvania, Vermont and New York. Of late years increased interest has been manifest in other States. This activity has been due to a great extent to an appreciable expansion in export trade. The total value of the slate produced in 1898 was $3,625,000, the product consisting of 1,082,605 squares of roofing, valued at $3,074,638, and about $550,362 worth of mill stock. The output in 1897 was valued at $3,243,225, of which $2,695,580 was for 895,372 squares of roofing slate and $547,645 for mill stock.

"Wild Cars" in the Slate Quarries of Wales.

The reports of Prof. C. Le Neve Foster, H. M. Inspector of Mines, relating to the North Wales districts, contain much that is of interest to the slate workers of this country. STONE takes pleasure in reproducing herewith two illustrations from a recent report, showing a car that is used by the Welsh slate workers in returning from their work. Prof. Foster says concerning these cars and the methods of their use:

"One of the workmen of the Bwlch-y-slater slate mine lost his life while descending an inclined plane on a so-called 'car.' As the accident took place when he was going home after work, and upon premises which did not belong to his employers, I have considered it right to exclude it from my list.

"At the Craig-ddu Quarry, near Blaenau Festiniog, there are three inclined planes, having a total length of 1,800 yards, with gradients varying from 8 degrees to 16 degrees. Nearly all the workmen, in order to save themselves the trouble of walking, ride down the incline upon little vehicles, which consist of a low seat supported by a wheel with two flanges and provided with a small hand brake (Figs. 1 and 2). Attached to the frame of the seat is a horizontal bar of iron, 3 feet long with a small guiding wheel at the end. Each inclined plane has two separate lines with a gauge of 23½ inches, which are 2 feet 6 inches apart. The workman places the main wheel of his car upon the inner rail of the road which is on his right hand when descending, and rests the guiding wheel upon the inner rail of the other road. He then sits down upon the seat, and keeping his feet just above the ground and holding his brake with his right hand, descends the inclined planes under the action of gravity at a very rapid rate; the speed is often so great that the car is locally known as 'car gwyllt' (wild car). For the average workman, the journey of 1,800 yards, with a descent of 1,040 feet, occupies about 8 minutes, including the time taken for walking from the bottom of each of the two upper inclined planes to the top of the one immediately below. When the workman has finished his rapid ride, he puts his car into one of the empty slate trucks, and it is drawn up to the top ready for the descent on the morrow.

"For those accustomed to the little vehicle, there is probably no more danger than in cycling or tobogganing; the risk comes in when the 'car' is used improperly, that is to say, when it is ridden without a regular brake, or is made to carry two persons instead of one.

"The Bwlch-y-slater workman on his way home had to pass through the Craig-ddu Quarry, and he borrowed a 'car' to make the descent. It appears that it had no brake, and though some of the practiced riders are content to use a piece of stone for the purpose, a novice, like the Bwlch-y-slater workman, who had never ridden on a 'car' before, naturally could not dispense with the appliance. His car was upset, he was thrown a long way, and picked up dead.

"One of the medical men at Festiniog broke his arm not long ago while descend-

FIGURE 1.

FIGURE 2.

ing one of the Craig-ddu inclined planes with the 'car.' The descent is so easy and rapid that one can understand that persons are tempted to try this means of locomotion; but the novice should invariably seek the advice of an old stager, see that his car is properly constructed, and refrain from making his first attempt if the atmos-

pheric conditions are unfavorable. In frosty weather the rails may be dangerously slippery.

"Since the fatal accident, the manager of Craig-ddu Quarry has established rules with the object of compelling the workmen to keep their 'cars' and brakes in good condition, and of preventing strangers from using them."

Slate-making is now in full force at all of the quarries. There is an excellent outlook for increased business, reported from all quarters, and the export trade to England and Germany is in a healthy condition. During the month of March the shipments from the Pennsylvania field were much larger than in February. The only unpleasant feature of the market is the demoralization in prices, but this is a condition that must always apply when there are many small producers. There is a talk of the inevitable trust and combinations, but it is likely to end in talk. The industry is not one that lends itself to a trust.

Griffin Bros. started up their school slate factory at Flicksville, the first of the month.

The Imperial Slate Company is slowly formulating a plan to work its quarry at Wind Gap, if arrangements can be made with the creditors.

C. J. Fitzgerald, A. Danville, J. E. Stofflet, John S. Romig and W. H. Budge will incorporate the Park Slate Company. They have leased and will operate the quarry and factory of the Wind Gap Slate Manufacturing Company, at Wind Gap, Pa., beginning operations the middle of this month. They will manufacture structural work and blackboards almost exclusively.

Harrison Krum has leased to the Consolidated Lehigh Slate Company, a tract of land containing about five acres, for a term of years, on which is situated the quarry which was formerly operated by the Empire Slate Company, at Pen Argyl. They are already engaged in pumping out the water and will employ a number of men.

William S. Iles, of London, the managing director of the American Slate Mart & Wharf Company, Ltd., has arrived in America, and will visit the principal slate producing fields in this country. Mr. Iles was met in New York by Mr. J. H. P. Keat, son of Samuel Keat, the sole representative of the company in this country. Mr. Iles has visited the Pennsylvania and Vermont slate quarries. E. Fitch Shepard, only son of the late Elliott F. Shepard, of New York, and grandson of the late William H. Vanderbilt, who resides abroad, was last month elected to a seat on the board of directors of the company. The company intends to open up branches on the continent of Europe, and they are now contemplating purchasing several steamers to be used to transport their slate.

The Albion Slate Company, of Bangor, Pa., will erect iron bridges across the Bangor & Portland railway track, and use part of the Albion farm south of the quarry for dumping purposes. The Albion will produce 5,000 squares of slate a month hereafter.

Pen Argyl's recently organized slaters' union already has one hundred members enrolled.

Heavy rains have caused a big cave-in at the Blue Mountain quarry, in the Pen Argyl region.

From present indications the Imperial, Wind Gap and Argyle quarries at Wind Gap will be put in operation this spring, with additional machinery and new men at each quarry.

Percolation Through Brick and Stone.

The results of some experiments to ascertain the most effective material for checking the percolation of water through brick or stone work are given by Mr. A. W. Hale in a recent number of the "Engineering and Mining Journal." The investigataion was mainly carried out in connection with the new Croton aqueduct of New York, and the substances employed in the experiments were numerous and varied. It was found that Portland cement gave the best results, and that the hydrocarbons, which are commonly regarded as suitable materials for rendering brick or stone impervious to water, oxidized by exposure to air and gradually disappeared. It was also found that a brick was rendered impervious to water by cement more rapidly when the cement was applied as a wash by means of a brush, than when applied with a trowel in the usual manner. A brick which had been treated with four cement washes was found at the expiration of two months to be quite impervious to water, even under a pressure of 200 pounds per square inch.

Limes and Cements

Articles of incorporation have been filed at Trenton, N. J., of the Continental Cement Company, with an authorized capital of $10,000,000 $5,000,000 of which is preferred and will bear 7 per cent. noncumulative dividends. The incorporators are: Thomas F. Gilroy, William H. Clark, Ralph Peverley, James C. Young, and Frank Stevens. It is said that the company will control 80 per cent. of the Portland cement output of the United States. Amzi L. Barber of the Barber Asphalt Paving Company and Charles R. Flint have been the chief movers in bringing about the combination. Baring, Magoun & Co. and F. S. Smithers & Co. are the bankers, and Davies, Stone & Auerbach are the counsel. The new company has closed an option on 600 acres of marl land near Bristol, Ind., and will erect a 1,000 barrel mill plant, at a cost of $250,000, if the marl beds warrant it.

Des Moines, Ia., invites proposals for cement sidewalks.

A plant with a capacity of between 1,000 and 3,000 barrels for making cement from slag will be erected at Ensley, Ala., near the big furnaces of the Tennessee Coal, Iron and Railroad Company. John Cheever in charge.

Work has been begun on a new cement mill at Quincy, Mich.

The Lawrence Cement Company and the New York and Rosendale Cement Company have begun grinding at their Rosendale mills.

Samuel B. Lawrence, Henry M. Haviland, George E. Spencer, Robert P. Barry, Jr., and James C. Young have incorporated the Birmingham Cement Company. Principal office, Jersey City; capital, $300,000.

The Coldwater "Courier" says that the Michigan Cement Company, located a mile west of that city, is buying more land adjacent to its plant; that on one piece lately acquired a bed of marl was discovered, absolutely of a pure white color, about the consistency of putty, which by chemical analysis proved to be 99 per cent. pure carbonate of lime. No other deposit of like purity was ever before discovered.

Seymour, Ind., invites proposals for several miles of cement walks.

St. Paul, Minn., has passed an ordinance for cement walks throughout the city.

The Citizens Cement Company has been incorporated at Penn Yan, New York, for the purpose of erecting cement works at Gorham, situated near Penn Yan.

The White Marble Lime Company, the Weston Lumber Company, and the Chicago Lumbering Company, all of Manistique, Mich., will jointly erect a Portland cement plant on their marl beds at Cedar Lake. They will expend $200,000 on the plant.

The Atlantic Cement Company, composed principally of New Yorkers, will establish a cement plant near Egypt, Lehigh County, Pa., with a capital stock of $300,000.

Wallace L. Hubbs, Charles B. Brady, and Katie E. Hubbs have incorporated the Warren Portland Cement Company, of Phillipsburg, N. J. Capital, $200,000.

The annual report of the assistant public engineer of Aurora, Ill., shows that nearly 10 miles of cement walks were laid in that city last year.

Stowe, Fuller & Co., an Ohio corporation, has filed a suit in the Erie County Common Pleas Court against the Sandusky Portland Cement Co., to recover $10,000 damages for alleged breach of contract.

The lime manufacturers of the Western States have met at Toledo and decided not to advance the price of lime this season.

The Castalia, O., Portland Cement Company will build an addition to its plant at that place with a daily capacity of 1,200 barrels.

The lime and cement dealers of St. Louis have organized to solicit subscriptions for

stock of the World's Fair in that city. C. W. S. Cobb has been elected president and A. Liemecke, secretary.

Smith & Kelly, of Rushville, Ind., have secured a contract for $15,000 worth of cement walks at Cambridge City. When the present job is finished the entire town will be paved in cement.

A. I. Hartshorn, of La Salle, Ill., has purchased 120 acres of land near La Salle for the purpose of a site for a new cement plant.

The steamer Miowera has taken 25,000 barrels of lime from Victoria, B. C., to Honolulu.

The Union Lime and Cement Company and the Louisville Cement Company, which operate mills at Sellersburg, Ind., have voluntarily increased the wages of their help 10 per cent.

The Michigan Portland Cement Co., of Detroit, have purchased 1,000 acres of marl land near Munith, Mich., and will erect a plant. A private railroad will be built to handle their product.

Madison A. Tipton, Edward Petty, William A. Schofield and Buel A. Wood have incorporated the Black Hills Lime Company at Pringle, S. D. Capital, $50,000.

The Alma Portland Cement Company, of Wellston, O., has increased its capital stock from $50,000 to $75,000.

The Cedar Valley, Ia., lime kilns will not run this season on account of high freight rates.

The current number of the "Canadian Architect" says: "There is a movement on the part of Canadian manufacturers of Portland cement to extend very much the present manufacturing facilities to enable them to supply to a much greater extent than heretofore the requirements of this market. At a recent meeting of the shareholders of the Owen Sound Portland Cement Company, it was decided to increase the capital stock of the company from $100,000 to $200,000. A new company, to be known as the Georgian Bay Portland Cement Company has also been organized at Owen Sound recently. This company propose to erect works on the Polson property. Kilns will be erected capable of turning out 125 barrels of cement per day, with other machinery having three times this capacity. The directors of this new company are: M. Kennedy, A. G. McKay, H. B. Harrison, S. Lloyd and J. W. Maitland. Mr. Kennedy is president, Mr. Harrison vice-president, and Mr. Maitland, secretary-treasurer. The Beaver Cement Company, the management of which is in the hands of a Montreal and British Syndicate, have recently acquired the cement deposit works at Marlbank, Ont., and propose to largely increase the output of the works. The works of the Rathbun Company at Napanee Mills have undergone constant enlargement and improvement, and are turning out not only Portland cement of the usual character, but also silicia sand cement."

Coal in Spain in 1898.

The coal statistics of Spain of the last year have a particular interest, since Spain has passed, or is passing, through a very heavy crisis. With the declaration of war the coal imports ceased, and this shows in the statistics. Whether the increased home production of coal has anything to do with the war, is not so easily ascertained. The navy, of course, bought up what coal it could obtain, and the home industry was slack. In the "Revista Minera Metalurgica y Ingenieria" we find the following figures. Spain produced during the years 1896, 1897, 1898, tons of coal 1,868,000 (we round off a little), 2,020,000, 2.466,800; and tons of lignite 55,400, 55,200, 59,800. Both these rows show a continual increase. There were imported in those years 1,447,350, 1,633,300, 1,215,550 tons of coal, and 325,300,298,500, 321,740 of coke. The exports of coal and coke were insignificant: 4,296, 2,539, 2,772 tons. In the production of coal, Asturias takes the lead; that province alone gave 1,543,000 tons, whilst of the other provinces only Cordoba figures with a little more than 30,000 tons. The total coke production of 1898 amounted to 308,375 tons; imported were 231,467, so that the coke consumption reached 539,842 tons. Asturias leads with 132,000 tons, but Vizcaya follows closely with a production of 115,000 tons of coke. The other provinces cannot yet compete, but Leon is decidedly coming to the front. In the lignite production, the provinces of Guipuzcoa, Barcelona, and one of the Balearic Isles share almost equally.

Marble and Granite

The most important news in the granite field during the past month has been the adjustment of the troubles between the Barre granite cutters and their employers, by which the strikers return to work pending a final decision by arbitration, and the settlement of the Quincy strike.

About 100,000 tons of granite was shipped from Stonington, Me., during the year 1898, as follows: J. L. Goss, 30,000 tons; Goss & Small, 25,000; Green Island Co., 20,000; S. E. Allen, 8,000; G. L. Bray, 4,000; P. G. Merrill, 3,000; Henry Robbins, 1,500; H. M. Thayer, 10,000; Calvin Ames, John McDonald and F. S. Warren, 500 tons each; Charles Grant, 5,000 tons.

The Waterville, Me., Granite Company has secured the contract for all cut stone of the Hebron dormitory for girls which is to be built at the expense of Mrs. B. F. Sturtevant, of Boston, at a cost of $65,000, as a gift to this institution. The stone which is of a pink hue will be from the Conway granite quarry.

Mr. C. A. Kleeberger has purchased the interest of Frank Stuart in the marble and granite firm of Stuart Bros., of Painesville, O., and the firm will now be called "The Painesville Marble & Granite Company." H. H. Stuart is president; C. A. Kleeberger, secretary and treasurer. The firm was established by Mr. Kleeberger's father, Peter Kleeberger, and his grandfather Stuart, who was H. H. Stuart's great-grandfather, 50 years ago.

C. Kinsey, now of Marinette, Mich., has decided to remove his marble and granite works to Menominee.

The Carthage, Mo., Marble & White Lime Company are building an additional mill for sawing Carthage stone, and the McNerney Bros. and others are putting in an entire new plant of quarrying machinery on land north of the river which they recently purchased.

Walter G. Robinson, who has been in the marble and granite business in Auburn, N. Y., for nearly 30 years, has retired and henceforth the business will be carried on by his two sons, Homer L. and Walter G. Robinson, Jr., under the firm name of Robinson Brothers.

R. M. Knox has purchased the interests of John Milligan in the firm of Knox & Milligan, marble and granite dealers, at Hoopeston, Ill., and the firm will now be known as the Knox Marble & Granite Company.

The Bodwell, Me., Granite Company has contracted to furnish for the Cathedral of St. John the Divine, New York, eight of the largest polished granite monoliths ever known to have been constructed. Two of these huge columns are to be 54 feet long by 6 feet in diameter, and six of them 51 feet and 9 inches long by 6 feet in diameter. They will be quarried at one of the company's quarries at Vinalhaven. As they first come from the ledge, in the rough, the weight of each stone will be about 175 tons. In shipping it will be necessary to load upon barges and tow to New York.

Clevelle & Fleck have started a marble and granite business at Peru, Ind.

C. M. Robinson, proprietor of the marble works at 221 and 223 Main street, Oshkosh, Wis., has bought out the Oshkosh Stone Company, 115 Main street. He will continue the business at both establishments.

The Elk River, Tenn., Marble Company has organized and elected the following officers: Thomas Parks, president; Wood Turney, vice-president; Marion Talley, secretary; Frank Lynch, treasurer.

Tobias Hermann, of Burlington, Ia., has bought the Doland Marble and Granite Works in Macomb.

T. F. Leak and George S. Bolton have opened a marble works at Montgomery, Ala.

The Tennessee Producers' Marble Company is filling an order for marble trimmings for all the interior work of the new postoffice building at Washington, D. C. The marble is the product of East Ten-

nessee. It is that beautiful variegated variety, to be found only in Hawkins county. The company is fulfilling this contract under some difficulties. The marble is quarried about 20 miles away from any railroad. It is hauled on wagons to Whitesburg, Tenn., and there loaded to be shipped to Knoxville, where it is finished.

Freeman & Argo, in the marble business at McMinnville, Tenn., have dissolved partnership, and Mr. Argo will continue the business alone.

John Torrey & Son, monument dealers, at Cadillac, Mich., have been succeeded by Torrey Bros.

Work has been begun on a 100-foot extension to the 300-foot shops of the Georgia Marble Furnishing Works, at Canton, Ga. The proprietor, Captain T. M. Brady, was recently elected mayor of Canton.

A marble factory is to be located at Hendricks, W. Va.

The marble business of Bryant & Cobb, at Rockland, Me., has been purchased by Charles W. Gale and Elijah H. Herrick, who have long been identified with the business. A. B. Cobb, who founded the business forty-six years ago, died in 1883. Mr. Samuel Bryant, who joined Mr. Cobb forty years ago, now retires at the age of seventy-six years.

Salley & White, of South Berwick and Dover, N. H., have bought the granite and marble business of C. W. Stevens, at Waterville, Me.

Ex-Sheriff C. M. Flinn, of Independence County, has purchased extensive marble works at Batesville, Ark.

The marble and granite firm of A. G. Krauss and B. W. Rice, at Attica, N. Y., has been dissolved, and the former will carry on the business alone. Mr. Rice has formed a partnership with Ralph French, of the same place.

Joseph Miller, who has a marble works on Neosho street, Burlington, Kan., has erected a new building, doubling the capacity of his plant.

The Maine & New Brunswick Granite Company of Portland, has taken the contract to furnish the granite for a large bank building in New York. It will require 150 cars to transport the stone.

The Dodlin granite quarries of Norridgewock, Me., which for the last few months have been shut down, are to be opened owing to several large contracts received, of which the largest are those for the stone of the Maine Central Railroad station at Brunswick and the stone for the Waterville & Wiscasset Railroad Bridge crossing the Kennebec River.

The State of Virginia is interested in a very large granite quarry on the grounds of the Central State Hospital, at Petersburg. The quarry has been in operation for some years and receives a royalty on every cubic foot taken out Virginia will make a hard fight to have this granite used for the new buildings at the Annapolis Naval Academy.

The marble men of Knoxville, Tenn., and vicinity are endeavoring to organize in order to establish the price of marble on a paying basis.

A Mammoth Block of Marble.

The Southern Marble Company, of Marble Hill, Ga., has won the distinction of taking from its quarries in Pickens County, one of the largest blocks of marble that has been quarried in the world during modern times. The marble was taken out last month, and has been shipped north for use in one of the contracts of the great firm of Norcross Brothers.

The block of marble is almost pure white and measures 27 feet, 2 inches long by 4 feet 3 inches wide, having in all the mass 500 cubic feet.

The officials of the company are proud of the fact that the block was removed after careful labor without a break, as it is considered very difficult to remove such a mass without some accident happening to it in the process of removal from the quarry.

The exact weight of the block, according to the statement of the manager of the company, is 100,066 pounds, requiring an immense amount of labor to finally place it on board the car for its journey to the north.

The next largest block of marble ever taken out of a quarry in Georgia was on exhibition at the Cotton States and International exposition and weighed only 45,200 pounds, or less than half of the weight of the monstrous block taken out last week.

Notice of the removal of the monster monolith was sent to Professor Yeates, of the Geological Survey, and a photograph of the block, just before it was put upon the cars, will be placed in the permanent exhibit of the Survey.

Monumental News

Plans for the soldiers' monument to be erected at the head of Market Square, in Kenosha, Wis., by Z. G. Simmons, have been prepared. It will be of granite and the shaft will be fifty-five feet high, in the form of an obelisk. The cost will be about $14,000.

The bill has become a law by the signature of the Governor of Oklahoma, appropriating $2,000 for a monument over the grave of Roy V. Cashon, the only Oklahoma volunteer to fall on the field of battle in the Spanish war.

A subscription is being taken up by the G. A. R., of Cherryvale, Kans., to erect a monument in memory of Capt. D. S. Elliott, who was shot at Caloocan, Philippine islands, and to others of the same company who may be killed. It will probably be erected in the reunion grounds at Cherryvale.

A committee has been appointed that will take up popular subscriptions for a monument in memory of Hamilton S. White, the lamented chief of the fire department of Syracuse, who died on duty. It is expected that many thousands of dollars will be raised. Mr. E. C. Stearns is the chairman of the committee.

A $15,000 bronze statue of the late Dr. William Pepper will probably be erected on the city hall plaza in Philadelphia. Dr. A. C. Lambdin is the chairman of the committee.

Missouri has appropriated $1,500 for a monument to be erected over the grave of the late Gov. John S. Marmaduke.

The Charter Oak chapter, Daughters of the American Revolution, have decided to erect a memorial to Faribault, the founder of the city that bears his name in Minnesota.

The Northampton (Pennsylvania) County Commissioners have awarded the contract for a soldiers' and sailors' monument, *to be erected in the public square of Easton, to the Eagle* Granite Company, of Reading. The monument will cost $14,000. It will be 75 feet in height, 26 feet square at the base and weigh 400 tons. The shaft will be surmounted by a figure, probably that of a soldier. At the base will be four statues, about seven or eight feet high, representing the four branches of the service—infantry, artillery, cavalry and the navy.

One of the last acts of the late Congress was to authorize the Secretary of War to erect at the expense of $5,000 a fitting monument over the remains of Sergt. Charles Floyd, a member of the Lewis and Clark expedition, who died Aug. 20, 1804, near the present site of Sioux City, Ia., and was the first soldier to lay down his life within the Louisiana purchase.

Illinois will build a $9,000 monument to Frances Willard.

An effort is being made to raise $10,000 for a monument at Jefferson City, Mo., to Hiram Bledsoe, commander of the famous Confederate battery.

John Merkle & Sons, of Peoria, were the successful bidders for the soldiers' monument that is to be erected in Oak Hill (Ill.) cemetery in the near future. It will be a sarcophagus of dark brown granite from the Vermont quarries.

Robert Myler, of South Bend, Ind., has donated two acres of land to the Northern Indiana and Southern Michigan Historical Society for a site for the monument to be erected in honor of Chevalier De La Salle, the explorer. The plat is one of the most picturesque spots on the St. Joseph River, and is the site where La Salle landed, over 200 years ago, on his voyage up the river, and established a post.

The Muldoon Monument Company, of Louisville, Ky., has secured the contract for a striking monument to the Confederate dead to be erected at Shelbyville, Tenn.

The P. N. Peterson Granite Company,

of St. Paul, Minn., has been awarded the contract for a monument to Dr. C. C. Salter, at Duluth. The design is modeled, in general, after the monument to the architect, Pierre Fontaine, at Valenciennes, France.

Portland is endeavoring to raise money for a monument to the Oregon volunteers in the Spanish war.

The Polish citizens of Chicago are raising $25,000 for a monument to Kosciusko.

A statue of Zebulon B. Vance will be erected at Raleigh, N. C.

The two statues which Maryland is to erect in Statuary Hall, at Washington, are to be of Charles Carroll, of Carrollton, and John Hanson, the first President of the Continental Congress. The sum of $24,000 is available for the statues.

Ten thousand dollars is given to the city of Youngstown, O., by the will of the late Laura E. Wick for the erection of a public drinking fountain in Central Square.

A good nucleus has been secured for a monument to Gen. Beauregard at New Orleans.

The Swedes of Minneapolis are raising funds for a monument to John Ericsson.

The Grove Cemetery Association of Glastonbury, Conn., will build a receiving vault.

James S. Clark, of Louisville, Ky., has secured the contract for a monument at Key West, Florida, to the Maine victims.

A movement has been started for the erection of a granite monument to Noah Webster in West Hartford, Conn., his birthplace.

Lehigh County, Pennsylvania, is going to erect a monument to its soldiers and sailors who perished during the Civil War. It will be erected at Allentown.

Messrs. Jaeggli & Martin, of Brenham, Texas, have secured the contract for the erection of a suitable shaft of Texas gray granite to mark the place where the declaration of Texas independence was signed.

The Mobile chapter of the United Confederate Veterans is considering plans submitted for a monument to Admiral Semmes.

A novel headstone of vitrified clay has been placed over the grave of Jesse C. Crall, the noted horse owner, of Atchison, Kans.

Mining Machinery for Russia.

The Russian Government has decided to permit all machines used in connection with the mining and reduction of gold ores to enter the country without the payment of duty. According to "Stahl and Eisen," the Russian Minister of Finance has prepared a list of machines which, under the new decision, may be imported duty free. The list includes machines used in gold washing, such as pumps, water pipes, machines for the hydraulic dressing of gold, hydraulic pumps for the treatment of gold bearing sands; also machinery for the treatment of gold ores, such as apparatus for fusing, for amalgamating, for the extraction of gold by the wet process, all kinds of furnaces, apparatus for the chlorination of gold, iron casks, and dynamos for the electrolytic separation of gold from cyanide solutions.

Machinery used for mining in general is also admitted free. Among such machinery are included dredgers, drilling machines, transporting apparatus, water pumping machinery, ventilators, and all kinds of mining apparatus.

The Effect of Heat on Different Kinds of Stone.

The injurious effects of artificial heat such as is produced by a burning building are of course greater when the temperature is highest. Unfortunately, sufficient and reliable data are not at hand for estimating accurately the enduring power of various stones under these trying circumstances. According to some experiments made by Dr. Cutting, the heat-resisting capacity of building stones when water is not applied, stand in the following order: 1. Marble; 2. Ordinary limestone; 3. Sandstone; 4. Granite; 5. Conglomerate. The limestones and marbles seldom crack from heat or water, but when the heat from the outside is excessive, they slightly crumble on the outside when water is thrown on them. When they are cooled without the application of water, the injury is much less. This is contrary to the generally conceived idea, which is that granite is a fire-resisting material, the fact being that marble is capable of resisting heat to a much greater extent.

Stone Trade Notes

New London, Wis., has between 400 and 500 cords of stone waiting to be crushed for street paving.

The Bay County, Mich., road commissioners, have awarded contracts for supplying hard-head crushed stone to W. C. Legg & Co., and for soft stone to the Bay Port quarries.

Work has been resumed at the D., L. & W. R. R. Co.'s stone quarry, near Shickshinny, N. J.

The firm of Nugent & Clark, stone dressers, of Murfreesboro, Tenn., has been dissolved. Mr. Clark retires and the business of the former firm will be carried on under the name of J. S. Nugent & Co.

Sandstone, Minn., stonecutters have not only been conceded the 8-hour day, but they receive $3 a day. They were paid $2.75 for nine hours.

Kansas City uses twenty stone crushers, and employs 1,000 men to operate them.

The capitol commissioners of Montana are looking through the quarries of that State in search for a good building sandstone for the new capitol.

The municipality of Cedar Rapids, Ia., will open a quarry for the purpose of getting out macadam. The city will use the Higley quarry at that place.

The Chippewa Sand and Stone Company has opened up a valuable tract of 160 acres of brown and buff building stone at Warwick, Ohio. The Chippewa Sand and Stone Company now has over 1,000 acres of valuable white, brown, buff and variegated sand rock leased near Warwick, and has a new sand mill in operation from which it is shipping much sand. Another new sand mill, on a large and modern scale, will be built on another lease this summer. It expects to develop four properties this year.

The Elwell bill, before the Minnesota *Legislature, authorizes* the board of managers of the State's prison to rent or purchase lands with quarries, the stone from which shall be used on the public highways of the State outside of cities. The sum of $20,000 is appropriated for the establishment of a rock crushing plant convenient to the prison. Convict labor will be used in carrying on the work.

The contract for quarrying and crushing stone at Dickerson's Station, Maryland, for the use of the District of Columbia Government, has been awarded by the District Commissioners to the Standard Lime and Stone Company.

The city council of Oconto, Wis., has purchased an Austin & Western stone crusher, and will install it at once.

Menominee, Wis., has bought during the winter 736 cords of stone, to be crushed by the new steam crusher, for stone roads and streets. Farmers have received $2.50 a cord for waste stone off their farms.

The stone quarries on the Mouser farm, near Marion, O., are soon to be worked. Two large stone crushers have been installed.

A. E. King has started in business as a general stone contractor, at Galesburg, Ill.

John A. Rogers, of Hartsell, Ala., will put in a stone crusher in connection with his gin mill and will purchase a road roller.

Charlton, N. Y., will vote on an appropriation of $900 to purchase a stone crusher.

Sarnia, Ont., will vote on the purchase of a road roller.

Sedalia, Mo., will receive bids for the purchase of a stone crusher.

The town of Bethlehem has appointed a committee to arrange for macadamizing the public road, between Bethlehem and Nazareth.

The Findlay, O., Crushed Stone Company has purchased machinery for its plant and will soon begin work. The company

is composed of Colonel John Jacob Astor and others who are interested in the Ft. Wayne and Western Railway. The company has purchased 35 acres of ground just at the city limits and will open a quarry, put in a number of large stone crushers, a large limekiln and cement works.

Heldmaier & Neu, the contractors for the San Pedro, Cal., breakwater, announce that they will obtain the stone for the riprap work from Catalina Island. The decision of this matter has awakened wide interest in Southern California. A quarrying plant, which has cost about $80,000 has been established on the island about thirteen miles north of Avalon.

The employees of the Carbon Limestone Company, of Newcastle, Pa., have been granted an advance in wages amounting to about 10 per cent.

Fred Hanger is getting out upwards of 300 carloads of stone for the government at the quarries a short distance above Little Rock. It is all shipped to Arkansas City, from which point it is distributed along the river wherever needed for revetment work.

The large stone quarries south of Dunbar, Pa., have been put in operation. They were formerly operated by Frank Renzi, of Allegheny, and are now run by Cotton & Smith, of Uniontown, employing 35 men.

W. F. Bowe, Charles F. McKenzie, John F. Holmes, Maurice Walton and W. H. Wingard have incorporated the Lithonia Crushed Stone Company, with offices at Augusta, Ga. Capital stock, $10,000.

Saginaw, Mich., is making vigorous efforts to secure stone roads.

Evan T. Thomas has opened his limestone quarries at Prospect, N. Y.

The town of Mount Pleasant, Westchester County, has decided to purchase a stone crusher.

The T., P. & W. Railroad has opened up a quarry near Hamilton, Ill., and will dig out rock and gravel for road-making purposes. It is said to be the intention to sell the product of the quarries to townships and cities along the line for the purpose of road building.

Advertisements have been issued for proposals for the construction of a stone dock at Portsmouth, N. H., by the Federal Government.

Georgia's Monument at Chickamauga.

The monument that is to be dedicated by the State of Georgia in Chickamauga National Park between May 1st and May 10th, will be a fitting tribute to the memory of the illustrious dead of the confederacy. The $25,000 that was appropriated by the Georgia Legislature for the purpose of the purchase and erection of the monument came as the result of patient and energetic effort in which the mothers and daughters of the confederacy were enthusiastic and willing workers.

The monument stands in the most conspicuous position at the Chickamauga Park, being erected on the spot where Benning's famous brigade did their heroic fighting on the battlefield of Chickamauga.

The Georgia monument is built from base to summit of Georgia blue granite, and is the work of the Venable Brothers, of Atlanta. The base is in the form of a three-cornered star, having a bronze statue of a confederate soldier on each corner. These statues represent an infantry soldier, an artilleryman, and a dismounted cavalryman.

The monument rises eighty feet in the air, and is capped by the bronze statue of a confederate color bearer.

In bronze relief on this monument is the coat-of-arms of the State of Georgia, and there are three panels upon which are inscribed the names of all the commanders and all the troops engaged in the battle of Chickamauga.

The bronze statues are of heroic form, and were made by the Gorham Manufacturing Company, of Providence. There are also 52 markers hewn from Stone Mountain granite by the Venable Brothers Company, placed to indicate the various confederate lines of battle in Chickamauga Park.

As far as possible the Georgia memorial used Georgia material in building the Georgia monument and the markers. A paved walk, sixty feet in diameter, has been laid around the Georgia monument. It is the only monument in the park with such a surrounding pavement.

The cost of the Georgia monument will be about $20,000. Both monument and "markers" will be completed within the appropriation first made for the purpose.

Contracts and Building

The contract for leveling and straightening the track of the LaCrosse division of the Milwaukee road has been let to J. A. and D. A. McIntosh, of Milwaukee, and work will be commenced within two weeks unless the conditions of the weather forbid. About 1,000,000 cubic yards of earth will have to be removed and the grade of the track raised in some places and depressed in others, while in several localities the line will be straightened.

In the construction of the Boston Southern Union railroad terminal there were used 43,000 spruce piles, 16,000,000 brick, 15,000 tons of steel, 200,000 feet of cut stone, 75,000 barrels of Portland cement, 20,000 bbls. Rosendale cement, 5,000,000 cubic feet of yellow pine timber, ten acres of gravel roofing, 150,000 square feet of wire glass, and 20,000 tons of putty for setting the glass. To paint the building called for 200 acres painting estimated as a single coat. Among its prominent features is an eagle on top of the front cut from a granite block weighing 20 tons, and the largest illuminated clock in the world, with a dial 14 feet in diameter. The capacity of the depot is for 4,000 trains in 18 hours, and 30 miles of rails in its shed. The cost of the depot is $14,000,000. Norcross Brothers of Worcester, Mass., were the contractors.

Public Buildings and Schools.

Savannah, Ga., contemplates building an auditorium at a cost of $75,000. No plans have been secured yet.

Ipswich, S. D., will erect a public building, the lower part to be used as an opera house, and the upper floors to be devoted to lodge purposes.

The Newport News and Old Point Railway and Electric Railway Company will build a $15,000 summer theatre at Bucksoe Beach.

A twenty-room school will be erected at Calument ave. and Twenty-seventh street, Chicago. W. B. Mundue, architect. Cost, $85,000. Contracts not let.

Jackson, Tenn., will erect a $25,000 city hall.

The St. Michaels Catholic Society will build a $26,000 school at Sutton Bay, Mich. Address, Rev. Alex. Zugelder, Provement, Mich.

The Portland (Me.) school board proposes to erect a $50,000 school building on Park street.

Port Chester, N. Y., will enlarge its primary school and build a new high school.

The S. S. Still College of Osteopathy is planning to build an $80,000 college building at West Fifteenth and Locust streets, Des Moines, Ia. Hallett & Rawson, architects, will prepare the plans.

A bill is before the New Jersey Legislature providing for an appropriation of $300,000 for a State Normal School, to be located at Newark.

A committee has been appointed to report on the matter of building a Masonic Temple at Appleton, Wis.

Wayne County, Ohio, Commissioners are considering plans for the remodeling of the county jail, which was recently condemned.

A vote will be taken at the spring election at Geneva, Ohio, on the question of issuing $30,000 school bonds. Plans have been prepared by the Owsley Company, of Youngstown.

The Orange (Mass.) town board voted $15,000 to enlarge the high school.

The plans and specifications of Dittoe & Wisenall for a courthouse at Covington, Ky., have been accepted and approved.

An appropriation of $230,000 has been set aside for furnishing the Rahway (N. J.) Reformatory. The wing will be fitted up with steel cells for the accommodation of 250 prisoners.

About May 1 contracts will be let for building the Trempeleau County Asylum at Whitehall, Wis. John Charles, Menomi-

nee, architect. The building will be constructed of stone, brick and iron. It will be about 200x120, and two stories high above the basement.

Gibson County, Tennessee, is to have a new courthouse at Trenton.

South Bend, Ind., will erect a $50,000 city hall.

Bids will be received April 24 for building a 16-room schoolhouse at Dayton, O. Mechanical heating and ventilating and dry closets will be used. William G. Haeussler, Clerk.

D. H. Burnham & Company, The Rookery, Chicago, have drawn plans for a public library at Kenosha, Wis. The building will be one and two story and basement, with a dome. Cost, $100,000. Contracts not let.

Plans have been prepared for a $12,000 schoolhouse at Wakefield, Neb.

The Board of Commissioners of Miami County, Indiana, will receive bids on April 22 for a new jail and sheriff's residence at Peru.

A $15,000 town hall and an $18,000 schoolhouse will be erected at Monessen, Pa.

Sand Beach, Mich., has voted $10,000 to rebuild its high school.

The city council of Chicago has appropriated $2,000,000 for new school buildings.

Plans for the erection of a $35,000 schoolhouse at New Castle, Pa., have been accepted.

J. L. Silsbee, No. 204 Dearborn street, Chicago, has prepared plans for a $50,000 high school at Polo, Ill.

The Martin County (Minnesota) Board has accepted plans prepared by the Pauly Jail Company for the $10,000 jail to be erected at Fairmont. Bids will soon be received.

The Winnebago County (Wisconsin) Board has decided to spend $20,000 in erecting a new jail at Oshkosh.

Scott County, Mississippi, will erect a $20,000 courthouse at Forest. Contracts not let.

Stoltze & Schick, of La Crosse, Wis., have prepared plans for an opera house to be erected at Spring Grove, Minn.

The commissioners of Clarion County, Pennsylvania, have agreed upon plans and specifications for a county home building; estimated cost, $40,000. The building will cover a ground space 114x201, and is calculated to accommodate 100 beds if needed.

W. Albert Swasey is preparing plans for a $300,000 Masonic hall at St. Louis.

The plans of George Berlinghoff, of Beatrice, for a new $30,000 courthouse at Wayne, Neb., have been accepted.

Hotels, Clubs and Dwellings.

At a citizens' mass meeting at Menominee, Mich., it was decided to build a three-story clubhouse, at a cost of $15,000, for a social and business men's club, recently organized. The building is to be completed by Nov. 1.

Plans are being prepared for the erection of a six-story hotel, to be erected on the site of the present Richmond House at North Adams, Mass.

Press report states that Bryant & Barber, of Polo, Ill., purchased of Leland, hotel property at Michigan avenue and Jackson street, Chicago, and will erect a large fire-proof hotel.

Architects are preparing plans for enlarging the Crescent Clubhouse, at 317 North Paca street, Baltimore, Md. A three-story addition will be erected, containing kitchens, dining-rooms and other necessary departments. A bowling alley will also be put in. The improvements will cost about $25,000.

Architect Harvey Wright has prepared plans for a four-story, $40,000 apartment house, of brick and Bedford stone, on Greenwood avenue, near Fifty-fourth street, Chicago.

A brick and stone hotel and bank building will be erected for C. O. Cooley, M. D., at Madelia, Minn. Frank Thayer, architect, Mankato, Minn.

The Woman's Club, of Denver, Colo., has adopted plans for remodeling the armory building, on Glenarm street, for club purposes. Estimated cost, $30,000. Mrs. S. S. Platt, Secretary of Building Committee.

An apartment house of brick and Bedford stone will be erected on the corner of Prairie avenue and Fifty-fourth street, Chicago. Cost, $50,000. H. L. Newhouse, architect.

The Church Club of the Episcopal Church, Twelfth and Walnut streets, Philadelphia, Pa., has under consideration the erection of a $12,000 clubhouse for boys.

H. L. Newhouse, 4630 Prairie avenue, Chicago, Ill., has prepared plans for four apartment houses of brick and Bedford stone, at 6210-16 Madison avenue, Chicago.

Samuel B. Harman will replace the hotel at Court and Willow streets, Williamsport, Pa., with a modern four-story structure. Wagner & Reitmeyer have prepared plans.

John G. Thurtle, of Indianapolis, has prepared plans for a $50,000 hotel, to be erected by C. M. Crawford, at Crawfordsville, Ind.

The executor of the Crawford estate has decided to remodel the Crawford House, at Windsor, Ont. The architect's estimate of the contemplated change is $15,000.

Esenwein & Johnson, of Buffalo, N. Y., have prepared plans for a four-story hotel to be erected at Exchange and Michigan streets by George Leyden.

E. W. Smith will soon begin the construction of flats at Ninth and Oak streets, Kansas City, Mo. The building will be designed by Van Brunt & Howe, architects, will be of brick and stone and will cost about $30,000.

Mrs. H. W. Roth will erect a $27,000 flat building on Seventh and Cedar streets, Milwaukee, Wis. Fred Graf, architect.

The Kalamazoo, Mich., Hotel Company has been incorporated, to erect a large new hotel at the Michigan Central Depot.

Business Buildings.

The Schwarzschild & Sulzberger Company will erect a packing-house plant embracing a number of buildings, on Ashland avenue, between Forty-first and Forty-third streets, Chicago. Cost, $800,000. Zachary T. Davis, architect. Contracts not let.

The Wilhelm Griessen Engineering Company, of Chicago, will erect a $100,000 malt house for the Sioux City, Ia., Brewing Company.

Messrs. Mimmons & Fellows, architects, have drawn plans for an addition to the *factory* of the McCormick Harvester Machinery Company, Blue Island and Western avenues, Chicago. Cost, $250,000. Contracts not let.

The Gast Brewing Company will build a co-operative brewery at Broadway and Hornsby avenue, St. Louis.

Plans are being prepared for a $200,000 business building to be erected on the corner of Fourth and Walnut streets, Cincinnati, O. C. G. Schnedlapp and A. B. Voorhies, owners.

Henry Ives Cobb, of 100 Washington street, Chicago, has prepared plans for an eight-story warehouse, at 207-11 Jackson boulevard, in that city, for the E. H. Sheldon estate. Cost, $165,000. Contracts not let.

The Baltimore & Ohio railway will build a new passenger depot at Sandusky, Ohio.

The Duquesne Brewing Company, of Pittsburg, Pa., will erect a plant in that city with an annual capacity of 100,000 barrels.

Chicago and St. Louis architects are preparing plans for a new plant, to be erected by Metz Bros., brewers, at Omaha, Neb. Estimated cost, $225,000.

The city council of Kenosha, Wis., granted to W. H. Schoot, of Chicago, a franchise to connect and maintain in the former city for a period of fifty years a public heating and hot water plant. The plant will supply heat from a central station and will be in operation by fall of this year. The plant for this purpose will cost over $50,000 and will be erected at once.

The D. Litz & Sons Brewing Company, of Allegheny, will erect an addition to the brewery on Spring Garden avenue at a cost of $300,000.

Seeler & Roberts, of Philadelphia, Pa., are preparing plans for an eighteen-story office building, to be erected on Broad street, near Chestnut. J. Wallace Hallowell, owner.

The Lindell Real Estate Company, of St. Louis, Mo., is planning to erect a seven-story building at Washington avenue and West Twelfth street. J. M. Carpenter, vice-president of the company, is promoter.

The Texas & Pacific railway contemplates building a $200,000 depot at New Orleans, La.

The Southern Railway Company will erect an additional building at Washington, D. C. Seven-stories, 190x35, fire-proof, clock-tower. Frank S. Gannon, General Manager.

B. F. Avery & Sons Plow Company, of Louisville, Ky., have made arrangements to erect a five-story office building and warehouse at Dallas, Texas. Estimated cost, $50,000. George C. Avery, president.

D. H. Burnham & Company have prepared plans for an additional story for the Marshall Field & Company building, Fifth avenue and Adams street, Chicago. It will be built of granite, and will cost $50,000.

The Schlitz Brewing Company, of Milwaukee, Wis., is preparing to erect a $60,000 beer depot in Denver.

L. G. Hallberg, 84 La Salle street, Chicago, has prepared plans for a five-story addition to August Turner's varnish factory, at Fourteenth place and Sangamon street. Cost, $25,000. Contracts not yet let.

Press report states that the Sante Fe railroad will commence the erection of shops at Topeka, Kans., this year. The new shop will cost in the neighborhood of $150,000, and will be equipped with the latest machinery for locomotive construction. After it is built, all Santa Fe locomotives will be built at that city.

Churches.

The M. E. Society of Canton, O., has selected the site for a $15,000 church to be erected this summer.

Plans have been prepared for the erection of a $10,000 Baptist church at Atlanta, Ga. D. G. Hughes, C. B. Ellis, building committee.

The Catholic Society, of Menominee, Wis., has decided to build a $20,000 church to replace the one recently burned. Rev. Joseph F. Volz, rector.

The Baptist Society has decided to build a new church on Sixth avenue and Cherry streets, Pine Bluff, Ark.

The Greenwood Baptist Society has decided to build a new church at Ninth street and Seventh avenue, New York. Rev. Dr. Robert B. Hull, pastor.

A committee has been appointed to take steps towards the immediate erection of a $25,000 church at Selma, Ala.

Galuke & Stewart, of Atlanta, are preparing plans for a new Presbyterian church at Spartensburg, Ga.

The Corpus Christi Catholic Society, of Chambersburg, Pa., is selecting plans for building a modern church. Rev. F. C. Noel, rector.

The Belmont Avenue Baptist Society, of Springfield, Mass., proposes to build a new church. Estimated cost, $25,000. Rev. W. E. Waterbury, pastor.

The M. E. Society, of Elwood, Ind., has decided to expend $25,000 in building a new church. Rev. L. M. Krider, pastor.

The Christian Society, of Vincennes, Ind., has decided to build an $85,000 church.

The M. E. Society, South, of Chillicothe, Mo., is planning to build an $18,000 church.

The Church of the Good Shepherd is a newly-organized Episcopal Society of Washington, D. C., which will build a new church. W. L. Conley, architect.

A. A. Small, E. E. Hendee and L. D. Ravling have been appointed a committee to secure plans for the erection of a $35,000 M. E. church at Kokomo, Ind.

The Globe Congregational Society, of Woonsocket, R. I., has accepted plans prepared by William M. Butterfield, of Manchester, N. H., for the erection of a new church. Estimated cost, $16,000.

The Catholic Society of the Immaculate Conception, of Fountain City, Wis., will soon ask for bids on the erection of a $20,000 church. Rev. Aloys Schanenberg, pastor.

Charlton, Gilbert & Demar, of Marquette, have been chosen architects for The Ste Anna French Catholic Church, at Calumet, Mich. Estimated cost, $20,000.

Bridges.

The Metropolitan Street Railway Company, of Kansas City, Mo., has been authorized to expend $1,500,000 in improvements. All the work of rebuilding old and new lines and viaducts will be under Walton H. Holmes.

A portion of the Pine Street bridge, built across the Cumberland River, at Pineville, Ky., at a cost of $25,000, has fallen. The piers were undermined by the water.

The Albany Railway Company will construct a bridge over the Hudson River, between Troy and Watervliet.

The Kings County (Washington) Commissioners have decided to build a steel bridge over the Snoguatime River at Novelty.

The Street Commissioner of St. Louis is preparing plans for a bridge over the

Terminal Railroad tracks at Ewing avenue.

Bids will be received at Chicago up to May 31 for the erection of the superstructure of a railroad bridge over the Desplaines River on the line of the Rock Island railroad in Joliet, Ill.

The stone arch over the east channel of the Mississippi River, at Minneapolis, will be enlarged.

A bridge will be erected across the Smith River, about sixteen miles south of Great Falls, and near Truly, Mont.

A bridge will be built over the East Hartford meadows, on the line of Hartford avenue, at Hartford, Conn. It will be 400 feet long and 64 feet wide. Bids will be received for a stone bridge and also for a street bridge on stone foundations.

The contract for the Choctaw and Memphis bridge over the Arkansas River, at Little Rock, has been awarded to McGee, Kahman & Co.

The B. & O. officials have decided to build a bridge across the Sandusky River near the site of the present structure, and the road will be double-tracked through the city of Tiffin entirely, and for some distance out of it.

Before the season is over it is probable that a new bridge will be built at Gordon Park, Cleveland, O.

The Southern Bridge Company has the contract to build a bridge across the Warrior River connecting Northport and Tuskaloosa, Ala. The price is $33,250.

One hundred and fifty feet of the state dam across the Scioto River, at Chillicothe, O., was carried away by the high water. The dam is becoming old and may have to be entirely reconstructed, which will cost about $50,000.

The question of issuing bonds to build a bridge across the Grand River at Paynesville, O., will be voted upon at the spring election. The cost of the bridge is not to exceed $35,000. J. E. Post, Lake County, Commissioner.

The Illinois Central railroad will rebuild the Dubuque-Duluth bridge.

Binghamton has issued $40,000 in bonds for a bridge at Tompkins street.

Plans are now being prepared in Kankakee, Ill., for another public bridge to replace the old one, at a cost of $80,000, which will be of stone or cement, and styled after the one recently built at Topeka, Kans.

Mayor H. P. Ford, of Pittsburg, Pa., has received a letter from the War Department at Washington, asking for plans for the bridge the city proposes to build in place of the old Tenth street structure. The new bridge can be built at a cost of $260,000 if the old piers are utilized, but should the War Department insist upon 500-foot spans, the cost would run up to $400,000.

The damaged bridge of the Allegheny Valley at West Penn Junction will be entirely replaced by a modern structure that will probably cost $100,000.

Scandinavian Granite.

The beauty of Scandinavian Granite has been nowhere more appreciated than in Paris. It has been selected as the material out of which 30 pillars are to be made for the splendid Memorial Church which is being erected at the scene of the terrible Charity Bazaar disaster which took place about two years ago, says the "Stonemason," which adds this curious bit of information: It was decided by the relatives of the dead and others to erect a magnificent church on the spot, and a sacred edifice is now being built at a cost of 7,000,000 fr., of which it is said that Jay Gould has contributed 1,000,000 in memory of some relative who perished in the flames. The pillars are to be of Labrador, and to form the supports of a gallery or arcaded balcony, running around the interior at a considerable height. The building is to be lighted by electricity, and the play of color on the stone, and the sparkling lustre, which is a feature of Scandinavian Granite, will produce a wonderful effect.

Legal Definition of Mineral.

The English courts have given a very comprehensive definition of the word "mineral." One of the notable cases is that of the Attorney General v. Tomline (L.R. 5 Ch. Div. 750), in which Lord Justice Fry held that "the word 'mineral' includes every substance which can be got from underneath the surface of the earth for the purpose of profit." In the case of Nisbet Hamilton vs. North British Railway Company (13 Ct. Sess. Cas. 4th series, 454, at page 461), Lord Adam said, "Common earth and sand are minerals."

Terre Haute, Ind., April 1.

The Terre Haute Stone Works Company has secured a contract for the stone work on a church at Paris, Ill. There are about 10,000 cubic feet of stone in the job. The entire building is faced with stone, Bedford Buff being specified. The foundation is already in.

In the past few weeks business in the building trades has been picking up, and the prospects are that this season will be a great improvement over recent years. Last December this city had a large and disastrous fire, buildings representing a frontage of about 225 feet, or about six stories, being burned out. Little was done in the way of replacing these buildings until a short time ago. One of the buildings destroyed was a department store, with a frontage of about 75 feet. The owner will not rebuild, as he has removed his business to Indianapolis, but it is reported that the property will be improved the coming season. One front of Green River, Ky., stone stood through the fire, and this is to be rebuilt, the two upper stories being taken down and replaced. Four of the buildings will also be replaced, the plans calling for three-story structures, mainly of brick and terra cotta. Mr. Myers, of Cincinnati, will erect a building of fifty feet front, ornamental Bedford stone, to replace two old structures that have been torn down.

The general prosperity of the town is shown by the fact that the Vandalia railroad shops are running ten hours a day and the Car Wheel and the Tool works are very busy. TERRE HAUTE.

Fort Worth, Texas, April 5.

The indications point to a good year in the Lone Star State. Trade in the stone line is gradually picking up. Work going on at the present time includes the Hoxie Bank building, the Central Fire Hall and several small jobs, giving employment to 17 or 18 stonecutters in all. The Texas & Pacific passenger depot has been let to Thompson & Gray, of St. Louis, Mo. There are about 12,000 cubic feet of Pecos red sandstone in. Bids have been received for the Texas & Pacific roundhouse and machine shops, and for a brick and stone passenger depot for the Santa Fe company. The contract for the Arizona State House has been let to Mr. Tom Lovell, a prominent contractor of this State. There is some talk of fine courthouses in Houston and Waco, but as yet no plans have been advertised for. GOWEN.

Peoria, Ill., April 3.

The building prospects in this city are bright. August Meyer is about to erect a store building, to cost $50,000. The committee on appropriations agreed to allow $550,000 for the Insane Asylum that is located here, $410,000 to be used on additions to the building, and maintenance receiving $140,000. The C., R. I. & P. R. R. Company is making preparations to start on a new depot here; total cost, including sheds, $100,000. The P. & P. U. R. R. Company is having plans prepared for the remodeling of the old Union station and intends to expend $100,000 on the improvements. A new public school has been let recently, costing about $40,000, Fred Mintz, of this city, securing the contract. Prospects in the building line are encouraging, but there is little going on at present, the weather being too severe, as we are now having the greatest snow storm of the winter season.

JOHN SCALLY.

Potsdam, April 6.

There is little activity in this section at present. Twelve stonecutters are working on a gate and lodge for the Bayside Cemetery, of this place. These handsome structures are a gift from the Clarkson family, and will cost about $10,000. E. K.

The Board of Supervisors of Monroe County, New York, will invite from all the bridge manufacturers plans and specifications for the steel bridge across the Genesee River. Estimated cost, $200,000.

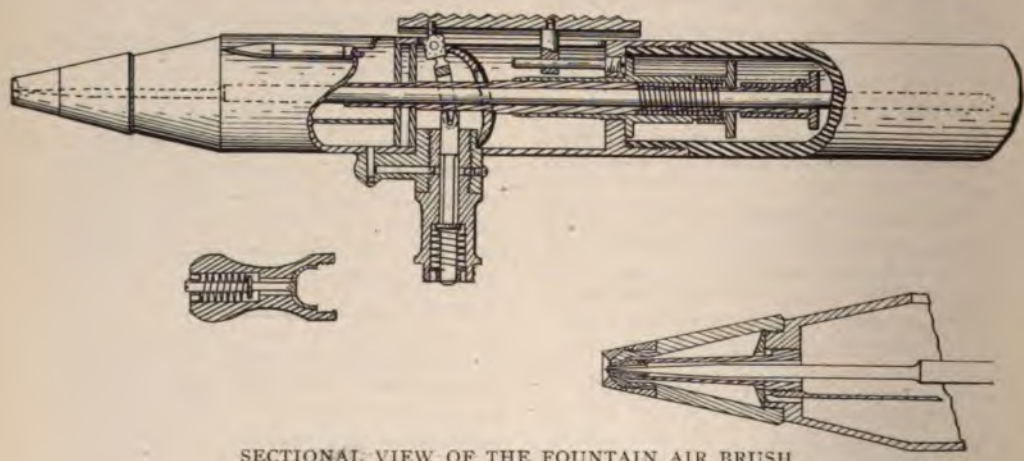
A bill providing for the appointment of an inspector of slate quarries, at a salary of $1,200 a year, has passed second reading in the Senate at Harrisburg.

Trade Notes

The New Albany Manufacturing Company has just completed a Gilmore patent double-planer, which will be shipped to Bedford for use in one of the quarries. It weighs 60,000 lbs. No class of stone-working machinery enjoys a higher reputation than that made by the New Albany Co.

Mr. Alfred C. Torbert, who has been general purchasing agent for a number of years of McArthur Brothers Company, of Chicago, and the Chicago Crushed Stone Company, has recently organized the firm of Alfred C. Torbert & Company, purchasing and selling agents for contractors and railroad plants of every description, mining and general machinery, etc., new and second-hand. Mr. Torbert's past experience and his present arrangements are such as place him in close touch with every company and firm or individual of any importance doing business in this line. His purpose in establishing his office has been to make it headquarters for contractors, engineers, builders, erectors, railroads, operators of mines, quarries, etc. The *firm has the advantage* of knowing who wants to buy, and what they want to buy; who wants to sell and what they want to sell. An advertisement of the new firm will be found on another page. From it readers of STONE will be able to learn a few of the bargains in second-hand machinery they have to offer at the present time.

For thousands of years those who have applied liquid colors for artistic and decorative purposes have been content to use a bunch of hair or bristles fastened to a stick. It was a useful tool, but crude for many of the purposes to which it was applied. It remained for a Yankee inventor, Mr. Abner Peeler, to make a machine, since improved by Mr. Walkup and others, which distributed liquid colors in the form of spray, and first opened to the artist this new and wonderful means of expression, and gave promise to the world of many and more beautiful works of art. It is the usual history of inventions that a roundabout and laborious method is adopted to produce results which are afterward accomplished by very simple and direct



SECTIONAL VIEW OF THE FOUNTAIN AIR BRUSH.

means. And paint distributors have been no exception to this rule. All of the unpleasant and complicated features of the early air brush have been done away with in the new invention perfected by Mr. Charles L. Burdick, of Chicago. The Fountain Air Brush is shaped like, and but

FOOT PUMP FOR THE FOUNTAIN AIR BRUSH.

little larger than a lead pencil, and is held in the hand in the manner of holding a pen or pencil. It contains no machinery but has simple operative parts, which, with ordinary care, should last a lifetime. It is so simple in construction that the novice need not get it out of order or find trouble in its management. The new brush has a marvelous capacity for applying color; distributing large quantities in a very short time, and yet adjustable for the finest line. The Fountain Air Brush has several features which have never before been incorporated in a spraying device for picture work. One of importance is the adjustment for fine or coarse spray, admirably adapting it alike for a fine, soft, close texture or a coarser, more transparent and sketchy effect. The accompanying illustrations give a better idea of the Brush than any printed description could. The manufacturers, Messrs. Thayer & Chandler, of Chicago, issue a handsomely illustrated circular, which will be sent to any address on request.

The M. C. Bullock Manufacturing Company, of Chicago, manufactures the celebrated Monarch drill, an illustration of which will be found elsewhere in this number. The standing that the Monarch drill has attained, not only in this country, but in the far parts of the world as well, is shown by the report just made by the agent of the company in New Zealand, who writes: "You will be pleased to hear that your drills obtained the first award at our exposition, shown in the same class with the drills manufactured by several well-known American firms, and Larmouth, of England. This award entitles you to the gold medal." The exposition referred to was the New Zealand Mining and Engineering exhibit.

The Davis-Johnson Company, of Chicago, are meeting with a large demand from quarry workers for the Johnson rotary pumps, which they manufacture. The pumps are specially suited for this class of work. They have no valves to get out of order, and the various parts are made of metal best adapted to the service to be performed. In the ordinary iron pump, the piston is made of metal of great tensile strength and as the piston heads do not pass entirely through the piston and shaft, as in some other makes, this part of their pump is not weakened. In this pump the piston does not bear on any point of inside of shell and consequently is not continually wearing away. On account of the small surface exposed to friction this pump requires but a minimum power to operate, and can be turned by hand. All parts are interchangeable, and this pump can be operated in either direction without any change whatever. The company issues a handsome pump album, which they will send to any address upon request.

The Ingersoll-Sergeant Drill Company, of No. 26 Cortlandt street, New York, has issued a handsome illustrated booklet, entitled, "Index of Ingersoll-Sergeant Rock Drills." This is devoted to the four types of rock drills made by the company, the Ingersoll "Eclipse," the "New Ingersoll," the "Sergeant" and the "Arc Valve" tappet, while there are also a few pages devoted to channeling and compressed air appliances. With a yearly output of 1,800 rock drills, and over 25,000 in use, the Ingersoll-Sergeant products are thoroughly established in favor.

The Sullivan Machinery Company, of Chicago, one of the foremost of all makers of stone-working machinery, has

opened a New York office in the Empire Building, No. 71 Broadway. This will be in charge of Mr. Arthur E. Blackwood. Mr. Blackwood will be pleased at any time to make quotations on the company's regular line of machinery—Diamond Prospecting Drills, Rock Drills, Channeling

SECTIONAL VIEW OF THE JOHNSON ROTARY PUMP.

Machines and Coal Mining Machinery. This new office will place the Sullivan Company even more closely in touch with the great quarrying industries of the East.

A business that was established a century ago, and that has grown and prospered with the flight of years, has something back of it beyond a mere name. William Jessop & Sons, Ltd., is such a business, and its continued prosperity is evidence of the high quality of its products. "Jessop's Steel" is a name to conjure with, and is known wherever the highest grade of tool steel is needed. Quarrymen are forced by the exacting nature of their work to give special attention to their tools, and Jessop's Steel is particularly fitted for all drills and stone-working tools. Full stocks are carried in many different localities, and quarrymen who wish to try the steel should write to the American depot, 91 John street, New York, for information as to the nearest point where it may be obtained.

All of our readers will be interested in the advertisement of Keuffel and Esser Co. because this company furnishes everything required for drawing and measuring. They are probably known to most of our readers, as they are the recognized leaders in their line of business, their goods are the standard of quality and their generously distributed catalogue is in the hands of *every professional.* They make most of *their goods and* absolutely control nearly all goods which they import, and they warrant all their goods to be exactly as represented, or better. They carry an immense assortment and probably the largest stock of any house in the world in their line. Their lavishly illustrated catalogue of over 400 pages is a model of terse, but efficient description, and is sent free of charge to professional people applying for it.

Quarrying in Ireland.

While the quarry-owners of Great Britain are complaining of the scarcity of labor and the impossibility of meeting the demand with satisfaction, quarry-owners in Ireland seem to be in an exactly opposite condition, says the "Stonemason." In Ireland there is an abundance of building stone, of granite and of marble. There are large deposits of granite in Donegal which are practically undeveloped, as well as those in County Down and County Armagh. There are the marbles of Down and Armagh, the red marble of Cork, the black of Kilkenny, and the green of Galway. The complaint is that heavy transit charges prevent the development of the industry. It is said that the cost of sending stone from Lahinch to Dublin is as much as all the expenses of quarrying, dressing, and delivering at Lahinch station. A movement, however, is on foot to bring the new County Councils, which are now being established all over the country, into contact with skilled engineers and practical scientists, with a view to develop the material wealth of the country. If this movement is well supported, and results in an improvement in methods of transit, the quarrying industry in Ireland should provide employment, which is badly needed by workmen in that country.

Cameos.

The art of engraving stones is of high antiquity, but it was for the most part confined to intaglio, or indenting, a simpler and easier process than relieving the work from a ground, and as such stones were used for signets or seals in very remote ages the intaglio mode of working seems to be the most natural, as well as the best adapted to the purpose, says an English

exchange. It has been supposed that the Etruscans had the art of engraving hard stones before it was known to the Greeks, and from the forms resembling those of the scarabaei of the Egyptians, it has been thought that their knowledge was derived from Egypt. Many engraved stones, however, that are called Etruscan are doubtless early Greek, as may be inferred from their subjects, and from the occurrence in the inscriptions of characters of a Greek form. The earliest Greek artist mentioned as an engraver of stones is Theodorus of Samos; Herodotus tells us that the famous ring of Polycrates "was the work of Theodorus, the son of Telecles the Samian." The first name of very great note that occurs in this branch of art is that of Pyrgoteles, who lived in the time of Alexander the Great, and who alone was permitted to engrave the portrait of Alexander. Tryphon deserves mention also in this place, being the author of a beautiful and well-known cameo which was in the Marlborough collection, representing the marriage of Cupid and Psyche. He is supposed on good authority to have lived under the immediate successors of Alexander in Macedon. The age of Augustus is remarkable for the excellence of the gem engravers who were then living. Among these Dioscorides, or more correctly Dioscourides, held the highest rank. He seems, however, to have worked chiefly in intaglio. Some of his productions have reached our times, and prove that the estimation in which he was held was not undeserved. Dioscorides was under Augustus what Pyrgoteles had been under Alexander. From Augustus down to Marcus Aurelius there were engravers of gems, both in cameo and intaglio, of very distinguished merit. They were chiefly Grecian artists who settled in Rome. There were, however, some Roman gem engravers who held a respectable rank, but the list is not considerable. The Greek artists preferred representing the naked figure, and the finest works produced in Greece are seldom draped, whilst those executed in Rome, whether by native or by Greek artists, are for the most part clothed. Dioscorides continued to follow the taste of his own nation and all his figures, with the exception of a Mercury in the Louvre, are believed to be naked.

The Tomb of St. Cuthbert.

A strange story of sepulture is that of St. Cuthbert, whose remains experienced many vicissitudes before they found a resting-place beneath the magnificent shrine of the great Norman-Gothic Cathedral of Durham, says the "Illustrated Carpenter and Builder." From Lindisfarne, where the body of the saint was first deposited, the monks, under stress of Danish invasion, carried it to many places before Durham was finally reached. Legend states that the saint made known that he would go no farther. After remaining for a time in a little chapel made by branches of trees, and then in a wooden church, the saint's body was in 998 placed in Ealdhun's church, built of stone. When in 1104 the body was transferred to the new church built by Bishop William, the curiosity of the monks led them to open the coffin. It is stated that they found the body in a state of incorruption, and with it the head of King Oswald, slain in 642, and other relics. In 1542 the magnificent shrine was defaced and the body buried beneath the floor of the church.

In May, 1827, the tomb was opened, apparently to gratify the curiosity of some of the cathedral clergy. The bones of the saint were found, and with them St. Oswald's head. The tomb has recently been opened once more under the supervision of the Dean, Canon Fowler, and Dr. Greenwell. They found the coffin entirely rotten. With the bones, presumed to be those of the saint, were found many others —possibly relics of other saints—including those of a child. A portion of what is believed to be the skull of St. Oswald was also there, with a part of the forehead sliced off as with the stroke of a sword. In the account of the examination, we are told: "The complete skeleton is that of a man of fifty (which was the age of St. Cuthbert), and of good height and strength. The skull is by no means of the low, unintellectual type given in Raine's representation of it, but is well balanced, with a slightly receding forehead. And nothing has been discovered which tends to strengthen the doubts, often expressed by Roman Catholics, as to whether this skeleton is really that of St. Cuthbert." It is intended to place the relics in a new oak coffin.

The Pulverizing of Talc.

Mr. J. Nelson Nevins has written an article on "Fibrous Talc in St. Lawrence County, New York," for a recent number of "The Engineering and Mining Journal." Mr. Nevins gives the following account of the process of pulverization as conducted at the International Pulp Company's mill, at Hailesboro, near Gouverneur:

The talc, as it comes from the mines, varies in size from dust to masses 2 ft. or more in length. As already mentioned, there is some difference in color, and considerable difference in texture and quality of the products of the different mines, but the materials are so mixed by experienced workmen that the finished product is of a uniform color and quality.

The process of pulverization consists of eight operations. (1) The larger masses of talc are reduced in size with a sledge, until the pieces are not more than 8 or 9 in. in greatest diameter. (2) It is passed through a Blake crusher and (3) fed by a belt between a pair of slightly corrugated steel rolls 30 in. in diameter, one of which acts against a rubber cushion which takes up the jar occasioned by the rolls striking the larger pieces of talc. These rolls reduce the talc to a size ¼ in. or less. When the rolls strike large fragments they spring apart and coarser material may get through them. (4) From these rolls the crushed talc is carried by an endless belt conveyor to bins on the top floor of the mill. During the day enough material is crushed to supply the mill during the night. (5) From these bins it feeds automatically into Griffin mills on the floor below. The Griffin mill consists of two inclosed steel plates which revolve rapidly in opposite directions, but are not in contact. The object of the space between the plates is to cause the talc to be crushed by striking against its own particles, thereby preventing the admixture of particles of iron that would be worn from the plates and might eventually discolor the pulp. A draft of air is forced through the mill, and as the talc becomes fairly fine it is blown through a conduit and falls to the floor below. (6) It is brought back to the second floor by a bucket-belt conveyor and dropped into large hopper-shaped bin-cars. These are used for storing, as well as for conveying, the material. They run on tracks which extend over a series of Alsing cylinders. There are made of steel, 6 ft. in diameter and 10 ft. in length; are lined with enameled, porcelain brick; are fitted with an opening in the side into which a cover screws, and are arranged to revolve horizontally about the long axis. (7) Into one of these cylinders the contents of a bin-car are emptied through an opening in the bottom. A quantity of water-worn quartz pebbles 2½ in. and smaller in diameter are placed in the cylinder along with the talc. The opening in the cylinder is then closed and the cylinder slowly revolved. The incessant pounding and rubbing of the pebbles as the cylinder revolves completes the pulverization of the talc. When this process is completed the cylinder is stopped, the cover of the aperture is removed and replaced by a grating, the spaces of which are ⅜ in. wide. The cylinder is again revolved, and the finely pulverized talc falls through the grating, while the pebbles and pieces of them that may have been broken are retained in the cylinder. (8) The pulp falls, from the Alsing cylinder, into a bin having a tapering bottom, which leads down to the automatic bag-filling device on the main floor. This machine loads approximately 50 lbs. of pulp into a paper bag which is placed beneath the spout by hand, and packs it by means of a revolving disc acting against the rising platform which carries the bag. The weight of the bag is then corrected on a scale, and the bag is loaded directly on the car for shipment. There are two bag-filling machines in this mill, each of which requires the services of two men to handle the bags, and fills about 200 bags an hour. The pulp is packed also in 160-lb. cloth bags.

St. Patrick's Cathedral, Dublin.

A paper was read at the meeting of the Royal Society of Antiquaries of Ireland Feb. 28, by Mr. Thomas Drew, R. H. A., entitled "A Further Note on the Surroundings of St. Patrick's de Insula, Dublin. Restoration of the North Close, 1899. The Possibility of Recovery of the Ancient Well of St. Patrick." He said the whole of the lands known as the Liberty of St. Sepulchre, near Dublin, were in 1190 possessed by the Archbishop of Dublin, and on them was the church of St. Patrick de Insula. The boundaries of the respective

plots have been strictly maintained for seven centuries. They are still definable on the south, east and west sides of the Cathedral in existing leaseholds, and were so on the north side until 1890. The Liberty of St. Patrick's, as created by Comyn, was walled and fortified, and dignitaries' houses were built. They were, however, not maintained. The exempt jurisdiction and property of the Dean and Chapter in the street traversing the ancient cemetery, and known to us as St. Patrick's Close, did not lapse until comparatively few years ago, and has for that interval vested in the corporation of Dublin. It is now sought, under a bill promoted last session in Parliament by Lords Ardilaun and Iveagh and Mr. James Talbot Power, to establish an open park or city garden on the north side of the Cathedral. It is proposed by it, inter alia, to restore to the Cathedral its verge assigned by its founder, Archbishop Comyn, in 1190, held by it for successive centuries, and essential as a foreground to the dignity of this ancient and stately church, which has been rescued, maintained and restored to the citizens of Dublin in the past thirty years by private munificence. The veritable ancient well of St. Patrick, where baptisms were traditionally said to have been performed by the saint himself, was, on the authority of Archbishop Ussher, who saw it in his time, enclosed in houses standing on the north Close. Antiquaries of reverent instinct and ecclesiologists are hereby warned of a coming chance of recovery of this famous and sacrosanct well, on the restoration of the ground sometime desecrated as a public street, and within the area of the houses marked on the map as in possession of Henry Hunt, or Rotton, in 1750, removed by the Wide Streets Commission in 1824. Bearing in mind that the inevitable accumulation process in city bounds has in seven centuries raised the surface of the ground six feet, and perhaps more, above the ancient ground level, a hope may be entertained by the pious that the well of St. Patrick is not lost for ever. It was seen by Ussher in Queen Elizabeth's day, and Malton, writing in 1790, took upon himself to say that it was still to be found under the hall of the house nearest depicted in his view of the west end of St. Patrick's. That it may be but covered up, and may be brought again to light is not *impossible*.

A Monster Blast in Wales.

"The Settmakers and Stoneworkers' Journal" gives an account of a monster blast in Wales, unique in that country, but nothing like as large as several that have been fired in this country. It is not comparable, for instance, with one that was exploded some years ago at the broken stone quarries at South Bethlehem, New York State. The "Journal" says: "Under the superintendence of Mr. George Farren, M. Inst. C. E., ex-president of the Liverpool Engineering Society, a monster blast took place in the quarries of the Welsh Granite Company, Limited, Trevor, Carnarvonshire, recently. The reason for the blast was that the rock was getting very tight and extremely difficult to get at. There have been no blasts of this character in such quarries in Wales before. There were two large blasts recently, one at Bethesda, and the other at Dinorwic Slate Quarries; but these were simply for the purpose of removing a quantity of rubbish, but there have been none for the purpose of getting good rock.

"The calculations for this blast were made with the greatest care and anxiety, for such a work, it need hardly be said, involves certain risks and dangers to those engaged in it, especially bearing in mind the liabilities under the Workmen's Compensation Act. The quarry is situated at 600 feet above sea level, and the bank to be operated on was 100 feet high. The plan of operations consisted in driving in a heading about 15 feet above the level of the bank. This heading was 53 feet long. Another heading, 23 feet long, was driven to the left from this, and a chamber formed there. A further tunnel was driven to the right, but nearer to the mouth of the first heading. This one was 29 feet long, and a chamber formed at the end. This was the state of things when the powder boat arrived. Everything being prepared by the shipping foreman Mr. W. Jones, the powder was quickly handed out, taken right up to the quarry along the rail and inclines more than a mile long, and placed under guard there during Saturday night, Sunday, and Sunday night. Monday came in with great gales of wind and torrents of rain, making it almost impossible to stand in the quarry, and the most delicate part of the operations began, viz., charging the chambers with the powder. Of course at

such a distance this was a serious operation, and the whole of the powder was got in on this day. Immediately this was done, two high-tension fuses were placed, one in each chamber, for communicating with a cable; but a further precaution was taken of placing duplicate fuses and another connection with the cable in case of a mis-fire by the first. For, in the case of a total mis-fire, there would have been nothing for it but untamping the whole of the work, which would have been an operation of extreme danger, difficulty, and cost to those engaged in it. No sooner was some turf placed in front of the powder than the work of tamping began. This was done with Portland cement, mortar, and large stones, and the whole made up as tight and strong as could be. This operation took up all Monday night, all Tuesday, and Tuesday night.

"By 8 o'clock on Wednesday morning the explosive was ready for firing. At 2 p. m. the steam whistle sounded as usual to fire, and immediately afterwards a 400-volt battery was applied by the highly intelligent foreman, Mr. Joseph Sharpe, assisted by Mr. Nicol, and the exp'osion instantly took place. There was very little report, which, of course, was good, and by measurement it was found that about 80,000 tons of rock were disp'aced, and fell on the bank exactly as prepared to receive it. A further quantity of 20,000 tons had been loosened. There were 6¼ tons of powder used as an exploding charge, and a small Siemens dynamo of 400 volts was used as the exploder. The sight was perfectly unique. The powder seemed to heave up the vast mass of granite, and then it fell pell-mell to the floor of the bank."

The Basilica.

What was the ancient heathen structure, the basilica, whose title has acquired a celebrity so far beyond its original intention? It is, as Chevalier Bunsen strikingly observes, the especial offspring and symbol of western civilization—Greek in its origin, Roman in its progress, Christian in its ultimate development; the word is co-extensive with the range of the European family. In the earliest form under which we can catch any trace of it, it stands in the dim antiquity of the Homeric age, at the point where the first beginnings of *Grecian civilization* melt away into the more primitive forms of Oriental society. It is the gateway of the royal palace in which the ancient kings, Agamemnon at Mycenæ, David at Jerusalem, Pharaoh at Thebes or Memphis, sat to hear and to judge the complaints of their people, and of which the last trace was preserved at Athens in the King's Portico under the Pnyx, where the Archon king performed the last judicial functions of the last shadow of the old Athenian royalty. But it was amongst the Romans that it first assumed that precise form and meaning which have given it so lasting an importance. Judging from the great prominence of the basilicas as public buildings and from the more extended application of them in the imperial times to purposes of general business, the nearest parallel to them in modern cities would doubtless be found in the town hall or exchange. What, in fact, the rock-hewn semicircle of the Pnyx was at Athens—what the open platform of the Forum had been in the earlier days of Rome itself—that in the later times of the Commonwealth was the basilica, the general place of popular resort and official transactions; but in accordance with the increased refinement of a more civilized age, protected from the midday sun and the occasional storm by walls and roof. Still, the original idea of a hall of justice which came with the name from Greece was never lost at Rome, and it was characteristic of the Eternal City that the predominant image which was impressed on its public buildings was not commercial, or religious, or even political, but judicial. A long hall divided by two rows of columns into a central avenue, with two side aisles, in one of which the male, in the other the female appellants to justice waited their turn; whilst the middle aisle was occupied by the chance crowd that assembled to hear the proceedings or for purposes of merchandise; a transverse avenue which crossed the other in the center, and if used at all was occupied by the advocates and others engaged in the public business; the whole building closed by a long semi-circular recess (the form, it is said, most convenient for hearing), in the center of which sat the prætor or supreme judge, seen high above the heads of all on the elevated tribunal, which was deemed the indispensable symbol of the Roman judgment-seat.

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Indian and American Mica.

It is only within recent years that Europeans have taken up the mica industry. Mining is still conducted on purely native methods, for in none of the mica districts is machinery of any kind used. Mr. A. Mervyn Smith says, in a paper read before the Institution of Mining and Metallurgy, that the same wasteful, slow and laborious system practiced by the natives for hundreds of years is still in vogue. Tufts of mica are discovered usually after exceptionally heavy rains, and these are marked off for mining as soon as the dry season begins. Books of mica are first split into plates about ⅛ in. thick, the mica being easily split into laminæ of any thickness. The trimmers are provided with sharp sickles, and the point of the knife is used for opening the sheets. Imperfect laminæ are now peeled off the plates till both surfaces show a clean, even face. After trimming, the plates are sorted for the European market, the United Kingdom and America being the chief buyers. The best quality is ruby mica, which is much used for the doors of glass and steel furnaces where extreme heat is required. Mica is not affected by the heat, and thus enables the workmen to look into the furnace and watch the crucibles of molten matter. Thin sheets are made into chimneys for incandescent gas burners; also for fire screens and for electrical purposes, as mica is an extremely bad conductor of electricity. A method of cementing sheets of mica into cardboard has been recently patented in Germany, and this cardboard is used for coating boilers, mica being a non-conductor of heat. It is also manufactured into helmets for fire brigade men, packing for fireproof rooms, etc. Thinner sheets are made into envelopes for wrapping valuable documents.

Dr. D. T. Day, in his recently issued volume of "The Mineral Resources of the United States, 1896-7," says: "While the domestic product in 1897 was larger than for several years, it was not much more than 25 per cent. of the value of the mica produced in the United States in 1884. The importation of India mica began in 1884, and its effect upon the domestic production was immediately apparent. Mica was on the free list prior to 1891, and the *inability of our mines to compete with it is shown in the* decrease from $368,525, the value of the domestic product in 1884, to $161,000 in 1895. In the 15 years preceding 1884, the value of imported mica had not exceeded $14,000, in any one year, and the average for the period was only $4,658 per annum. In 1884 and 1885 the value of the importations was not large, being something over $28,000 in each year. This was, however, for rough mica, and no estimate can be made as to the value of the cut mica obtained from it. The same may be said of the years succeeding 1885. The demoralization of the mica-mining industry in the United States since 1884 is the best indication that the value of the imported mica has not been overstated. In the five years 1880 to 1884, inclusive, the value of our domestic product averaged $256,000 annually. In the next 12 years, ending with 1896, the average annual value of the product was $86,000. During the same period the imports averaged nearly $120,000. That is to say, the average value of the domestic product in the two periods shows a decline of 66⅔ per cent., while the value of the imports in the second period was more than 25 times that of the first. The average value of the domestic product in the first period was more than 50 times that of the imported. In the second period the value of the imported mica has been nearly 1½ times that of the domestic, and as stated before, the values given for the imported product particularly during the years 1891 to July, 1897, when an ad valorem duty was imposed, have not been excessive. The value of the domestic product in 1897 was about one-half that of the imported.

Cracks in Steel Tools.

It frequently happens that with tool steel, even of excellent quality, fine cracks develop in the tempering, and if these are not observed and removed by cutting-off, they render the tool useless for cutting purposes. A German contemporary recommends a simple way of making such faults visible to the naked eye. The tool, near the cutting edge, is to be dipped in petroleum, which must be rubbed off clean and the surface then wiped over with chalk. The petroleum, which has entered the fine cracks, sweats out of the chalk, and the rent is visible in its whole extent.

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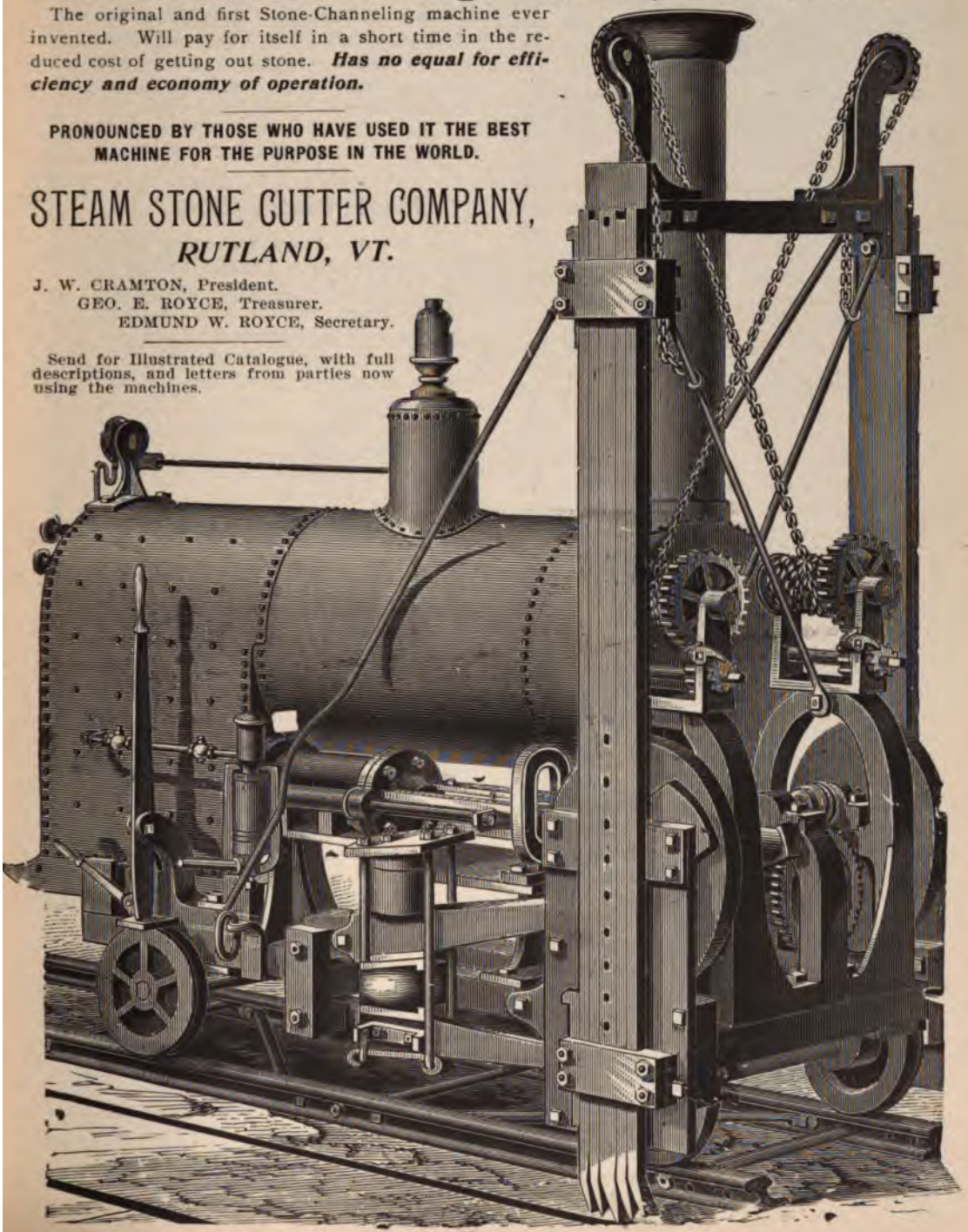

Careless Building in England.

The architects and builders of England are not wholly free from the reproach of cheap and careless construction.

The fabric of St. Luke's Church, Birmingham, although erected only a litle over 50 years ago, has long been falling into decay, and considerable fear is entertained that the whole building may collapse. The attention of the city authorities has, says the Liverpool "Courier," been directed to the matter, and as the result of a careful inspection of the structure it has been condemned as dangerous. Some few years ago the south wall showed signs of giving way, and that side of the church was propped up by stout pieces of timber. At the time this step was taken it was apparent that the fabric of the church as a whole was gradually giving way, and that the time was not far distant when it would become so dangerous and such a menace to public safety that it would have to be razed. Recently the process of decay has proceeded so rapidly that in the opinion of experts the condition of the building is such that further delay in either closing it for worship and pulling it down would be a source of danger. The internal columns are leaning to such an extent that they resemble so many towers of Pisa. They are falling outward, and as the external walls are giving way in the same direction there is the possibility of the north and south aisles tumbling down and the nave collapsing. The tower, too, appears none too safe. Indead, owing to the perishing of the stonework the top part of the turret depends entirely upon a few attenuated supports. The walls of the tower and the gable ends have perished to a remarkable extent both inside and out, and the east gable end of the south aisle has decayed to such a degree that there are holes in the walls through which the birds fly in and out. The other gables are in little, if any, better condition, and the circular window of stained-glass at the end of the chancel is only kept in position by a strong piece of wood which is nailed across it. The cause of the dilapidated state of the church is due to the soft and yielding nature of the stone emp'oyed in the erection of the fabric, and also the fact that although the walls are of considerable thickness they are simply "faced" *with the* stone, the interior being filled in *with rubble. To look* at the church one would think that it was built in the year 1481 instead of 1841. It was one of four built by the Birmingham Church Building Society in the forties. The others were St. Andrew's, St. Setphen's and St. Mark's. They were all built of the same kind of red sandstone, and all are in a sad state of decay. St. Luke's was erected at a cost of 3,700*l.*, the stone being given, and it has accommodation for 800 worshippers.

Marble Ponds of Persia.

That beautiful transparent stone called Tabriz marble, much used in the burial places of Persia and in their grandest edifices, consists of petrified water of ponds in certain parts of the country. This petrifaction may be traced from its commencement to its termination; in one part the water is clear, in a second it appears thicker and stagnant, in a third quite black, and in its last stage it is white like frost. When the operation is complete, a stone thrown on its surface makes no impression, and one may walk over it without wetting one's shoes. The substance thus produced is brittle and transparent, and sometimes richly striped with red green, and copper color. So much is this marble, which may be cut into large slabs, looked upon as a luxury, that none but the king, his sons, and persons specially privileged, are permitted to take it.

Deep Boring in Coral.

A progress report has been received from the scientific expedition sent to the island of Funafuti, in the Pacific, to continue the work of coral-boring commenced there by Professor Sollas, of London, and Professor David, of Sydney, with the object of ascertaining the mode of origin and growth of coral atolls. The report states that the bore sunk by the David expedition to 698 feet had been carried down to 1,114 feet, when operations had to be discontinued owing to the supply of diamonds having become exhausted. It is thought that the result will establish the correctness of Darwin's theory, that the atolls had sunk to their present great depth through a slow subsidence.

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The Houses of the Picts.

There are stone remains in Scotland of a dreary and mysterious darkness—the Picts' houses, or Eird houses of the north, belonging to an age who shall say how many centuries older than that of the old square keeps? You enter crawling along a cavernous drain-like passage, which descends and widens into a chamber. This chamber may be from 3 to 6 feet high and 20 or 30 feet long. Its sides are made of rough huge stones, laid on each other so that the walls converge upwards, where great blocks of granite are laid across them. You pass through a lateral narrow opening, and enter another chamber of a like character. Some of these houses have three or more chambers. They are not with in fields, where the husbandman has for centuries passed the plough over them, unconscious of their existence, or of any farther peculiarity than a slight ascent, with a projecting stone or two dangerous to the plough. Nor are these cavernous edifices mere rare anomalies. In some places, and chiefly in the upper basin of the Don, there are complete villages of them. Professor Stuart, in a paper read to the Antiquarian Society of Scotland, mentioned between forty and fifty as the number opened in one parish. It is in the Orkney Isles, however, that they are found on the largest scale, and most elaborately built. The tradition of the country, not unnaturally, associates these and other mysterious antiquities with a race which according to the popular but now superseded history of Scotland, was extinguished in conflict with the nation now occupying the soil. Hence they are deemed the dwelling-places of the Picts or Pechts, being endowed with elfish faculties and malign propensities. They are supposed to have been of superhuman strength, but diminutive and dark, and no wonder when such were their habitations. With the Orcadians, the possible existence of a lingering remnant of the Pechts, dwelling in the recesses of the earth, is still a matter of substantial apprehension. Mr. Stevenson, the engineer, the father of the author of "Treasure Island," when passing through Orkney on lighthouse business, was called upon by the people of a small tavern to decide for them a very important point. A being was then asleep in one of their beds whom they verily believed to be a remnant of the accursed and not quite extinguished race—so diminutive was he and so black withal. Now, if their suspicions were well founded, they would be under the disagreeable necessity of putting him to death, and this was just the question which Mr. Stevenson, being a lighthouse engineer, should decide for them. On entering the chamber, Mr. Stevenson, with curious sensations beheld, in unconscious and peaceful repose, the familiar face of an old schoolfellow. He was a being of slender proportions and not very comely visage, but of a restless, enterprising, enthusiastic character, being no other than the Rev. John Campbell, subsequently renowned in African missionary history. Did, then, human beings live here in chambers not much wider than graves, in contact with the slimy walls and with the company of a few snails and toads?—no rats, for the rat would not inhabit such a place. That houses of this laborious structure should have been built for the people at large is out of the question, so that we must suppose them to have been in a manner the mansions of the aristocracy.—The Architect and Contract Reporter.

American Manufactures in England.

A good deal of comment has been caused by the news that the contract for the bridge which is to carry the new Soudan Railway over the River Atbara has been given to an American firm, and it seems to have been assumed in some quarters that a transatlantic ironmaster had been preferred to a British manufacturer, and that the Egyptian Government had gone out of its way to ignore this country, says the London "Times." But the facts are exactly the reverse. The English agents for the Egyptian Government, who had the ordering of the Atbara bridge, gave the first chance to British traders, and would doubtless have given them the sole chance but for the imperative importance of speedy delivery. Of the British ironmasters approached not one could guarantee delivery in the time at which delivery was required. One English firm ran the Americans pretty close as to time; but speed being of paramount importance, and as the Americans could insure it in the greatest measure, there was no choice but to go to them for the work. In contrast to the promptitude with which they

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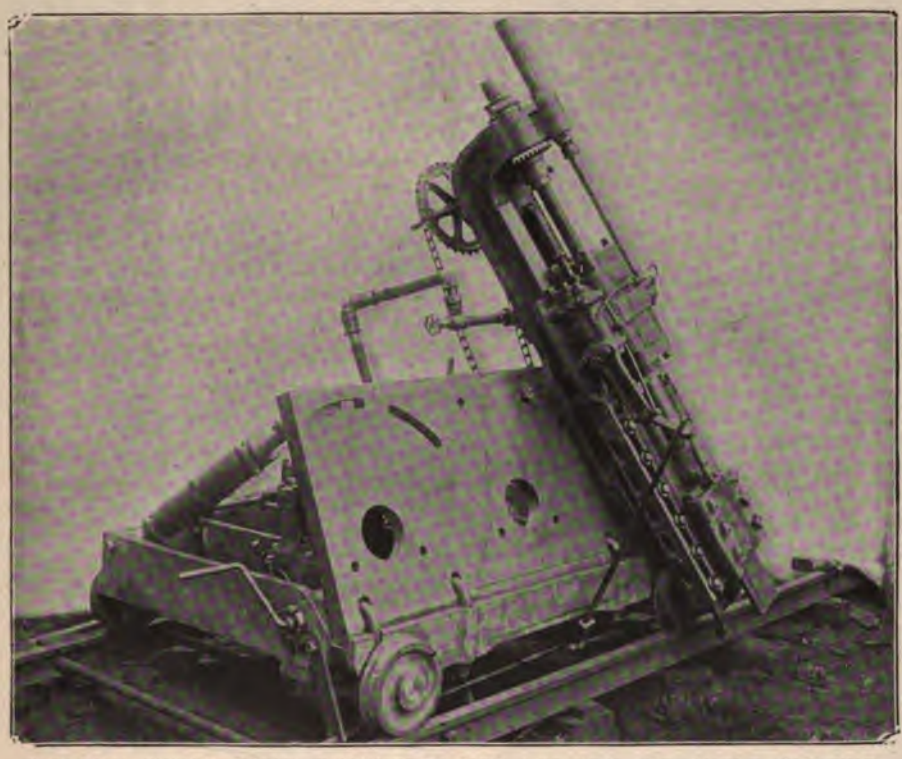

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have shipped the component parts of the bridge may be placed the fact that the agents of the Egyptian Government had to wait four months for one small bridge of thirty-one tons ordered in England. Probably the recent engineering dispute was responsible for this. It will be found that the locomotives for the Soudan Railway, or, at all events, the first batch delivered, will come from America. The reason in this case is precisely the same. The desire is to get delivery with all possible dispatch, and as America is in a position to guarantee greater speed than England, the Government agents, with every desire to place their orders here, have had no choice but to go to the States for at least that portion of the order which could not wait.

Stone in Old English Buildings.

In nearly all the old English buildings we rarely find a stone larger than might be conveniently moved or carried by two or three men, and there is no good reason to believe that, notwithstanding the quarry might be but a few miles distant, probably over hills and dales, the most practicable mode of conveying the stone to the building was by pack-horses, of either single or double burden, says the "Stonemason." While the numerous disadvantages existed, we need not be surprised to find materials of an inferior quality used, for the sake of convenience, in the construction of all kinds of edifices, and frequently even in those of a magnificent character. No doubt these circumstances originated sometimes from necessity, at other times through ignorance; but an attentive examination of various old buildings will soon convince us that economy was formerly, as it too often is now, the ruling power, far more so than a casual observer would imagine. Even at one of our principal seminaries of learning there is a remarkable instance of ostentatious display executed in the most fragile stone ever beheld. Nearly all the colleges, halls, churches and other public buildings at Oxford present elegant architectural designs, and, with few exceptions, they are all now in the most ridiculous-looking state of decomposition. Here we have an evident proof that those who had the direction of the works knew they *were using a bad material*, because in many examples the greater part of each structure is executed in Heddington stone, which is procured from quarries about a mile or two from the University, and may be worked with great facility; but wherever it has been used the result is deplorable in the extreme, every exposed surface appearing affected by what in medical language would be termed "a cutaneous disease," peeling off and hanging like paper or rags. But the more exposed parts of the same buildings, such as base mouldings or cornices, are formed of a very superior stone from the Taynton quarries, distant about twelve miles land carriage, which increases very considerably the expense of such material; it is therefore rarely introduced. But, notwithstanding the Taynton stone has always been put in situations most likely to be affected by the weather, it almost invariably appears to be in an excellent state of preservation, and fit to be again used without fresh working the surface in all cases where the buildings have been restored or rebuilt according to original design.

Fires in Roofs.

Astonishment is frequently expressed at the rapid spreading of fires which occur in the roof spars. The flames distinctly break out in the one gable, then appear at the other, and suddenly the whole roof is on fire. We are inclined in such cases to believe in several sources of the fire, and to harbor a suspicion of incendiarism. According to Sendtner, a fire brigade officer of Munich, that suspicion may be quite unjustified. He saw that one of the rafters at the end of a hall had caught fire. The hall became filled with smoke, but he distinctly observed that little blue flames began to creep along the beams; they reached the other gable, found more convenient ground there, and all at once the whole roof was ablaze. The observation suggested to him that the fire spreads with the aid of a kind of dry distillation in the wood. Experiments confirm this view. We read in the "Gesundheits-Ingenieur" that he rigged up roof models of spars and sheet iron without any intermediate wooden parts, and set fire to the lower end of a spar in the one gable. The hot gases traveled along the ridge, the other gable caught fire, and soon all the spars burned as if each had been set fire to.

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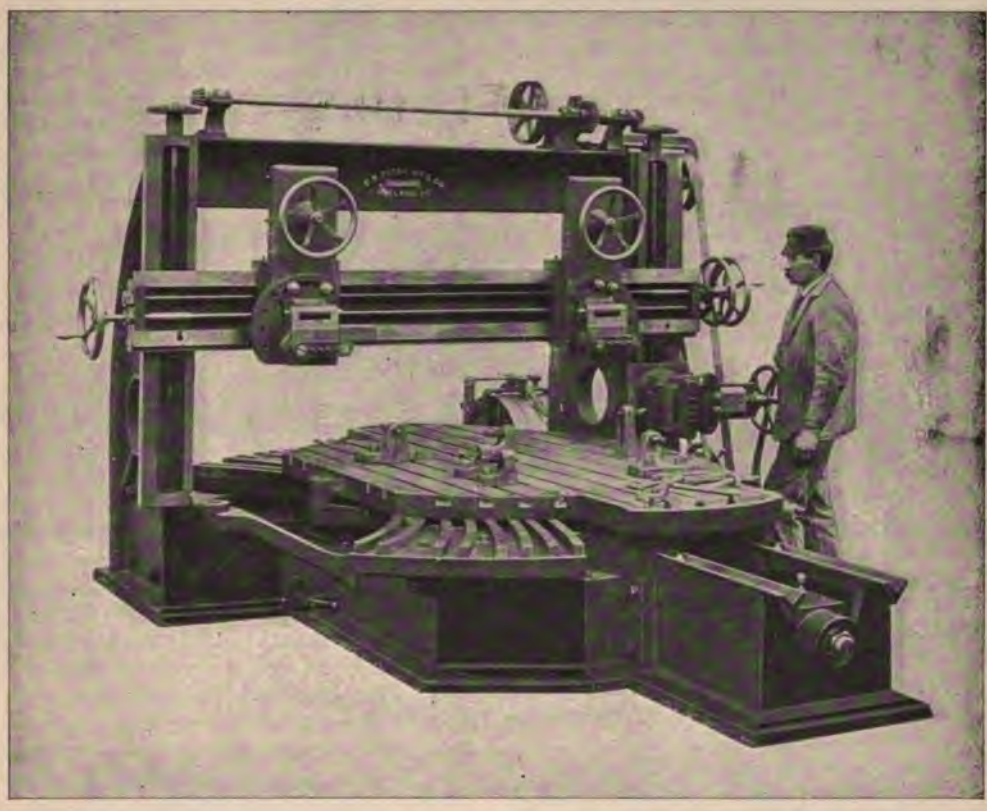

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The most important kinds of Greek marbles were the Hymettian, in Xenophon's time, used chiefly for temples, altars, statues, etc., throughout Greece, but especially at Athens; the Pentelican, first mentioned by Æschines, who lived in the 86th Olympiad, also by Theophrastus; the Parian, very white. The other kinds shall be given alphabetically. Atracian, green and white. Basalt, one black the other green, both Egyptian; statues of the former are more frequent than of the latter. Bosporian, Greek, undefined. Caristian, Greek, green, variegated with spots, a sub-variety of the verde antico. Caralitican, Greek, undefined. Chian, Greek, variegated. Corinthian, Greek, variegated, but chiefly yellow. Cubelican, Greek, undefined. Docimæan, called also Synnadican, Greek. Granite, Egyptian, etc., of two kinds; white mixed with black, and red mixed with a sort of white, this last being limited to Egypt. All the obelisks and many statues are made of it. Hierosolymitan, Greek. Lucullum Marmor, a black marble without veins; the Italian Nero-Antico, the Marbre de Namur, etc. Lygdinum Marmor, or Lydus Lapis, a very fine marble or alabaster of exceeding whiteness, used for vases and ornaments. Pliny says that it was brought from Mount Taurus in Asia, and Chardin there found some. It was not a marble, but formed as stalactites. Marmor Conchute, much used in works at Megara. Marmor Porinum, called also Porus, white like the Parian, but light as Toph. Melian, yellow. Mylessensian, Alabrandine, Jassensian and Ephesian, all undefined. The Melleum Marmor was marble of a honey color found in many parts of Italy. Phengites lapis, found in Cappadocia, so transparent that Pliny says (xxxvi. 22) a temple was built of it without windows, which gave a dim light. Phelling is lapis from Mount Phelleus in Attica, mentioned by Aristophanes. Porphyry; there are two kinds, the red, Pliny's pyropæcilon, and the green, of which there are known only columns. The statues of red porphyry which have descended to us are for the most part captive kings, with which the Romans decorated their triumphal cars and public edifices. They may be considered as the works of Greek artists under the Ptolemies or under the Emperors. Ancient statues of this material have the head, hands and feet of a different substance. Proconnesian, Greek, undefined. Rhodian, Greek, undefined. Scyrian, Deucalian and Hierapolytican, also Lydian of two kinds, Lesbian and Heraclean. Tænarian of two kinds, from Tænarium, a promontory in Laconia. It was green and black. Tauromenitan, Syracusian, Tragusian and Molossian. Thasian, like Parian. Trondensian, Tyrian, white, from Libanus. Verd Antique, the Tiberium Marmor, or Marmor Augustum, imported from Egypt, green, full of white spots or veins. Pliny under the countries mentions other kinds of marbles.—The Stonemason.

The Palace of Caserta.

About thirteen miles from Naples is one of the finest kingly residences in Europe, so say all the guide books, and they are right. Vanvitelli is the very Michael Angelo of palace rearing. The building was constructed in 1752. Its shape is a parallelogram approaching to a square. Counting mezzanines, it has six stories besides the attic, and is pierced with no less than 1,700 windows. Its stair, the very perfection of that sort of construction, is vast in all its dimensions and so very easy that you look down from its summit admiring with untried lungs the enormous height you have reached. It starts double from the ground, and twenty persons might ascend either branch abreast and meet one another at the spot where it begins to return upon itself, so that the noble octagonal landing above finds itself just over the starting place below. From this post four large windows command four spacious courts, and the simple construction of this gigantic edifice stands unveiled. You now begin your journey through vast, lofty, magnificently marbled, and very ill-furnished apartments, of which, before you have completed the half circuit of a single floor, you are heartily tired, for beyond the architecture there is nothing to see. The commonest broker's shop would furnish better pictures. Boar hunts, of course, to represent how Neapolitan kings kill boars at Portici, and shoot wild ducks on the Lago di Fusina. There is also an ample historical fresco on the ceiling of the antechamber to the throne room, on which Murat had caused to be represented some notable charge where he proved victor-

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ious; but after he was shot Ferdinand, with great taste, judgment, and good feeling, erased, interpolated, and altered the picture into a harmless battle of Trojans against Greeks, or some such thing. The palace has two theatres and a chapel, and you must change your conductor four times if you would be led through the whole. Caserta has cost 7,000,000 scudi. It may have something of the formality of Versailles or Chantilly, but its leading features are essentially English. Its thickets and copses abound in hares and pheasants. The ilex attains twice the height we remember to have seen it reach elsewhere. Its islands and fishponds, its kitchen and flower gardens, put one in mind of a first rate English country seat. The ornamental water is fetched by an aqueduct worthy of old Rome from mountains seven miles off, first emptying its whole charge over a high ledge of rock, making a waterfall (which you see from the drawing room window) over a series of steps and terraces, which get wider as they get lower, till they terminate in a superb basin within a quarter of a mile of the palace, where the water makes its last bound, and forms a broad lake fit for Diana and her nymphs amidst woods fit for Actæon and his dogs. —Illustrated Architect and Builder.

Dredging the Volga.

One of two dredges, to cost in all 2,900,000 francs, to be used by the Russian government in deepening and widening the Volga preparatory to digging a ship canal from that river to the Baltic sea, has been built by the Societe John Cockerill at Seraing, Belgium, and is being tested on the Scheldt near Antwerp. It is built like the dredge "Beta," in use on the Mississippi, but is very much larger, being able to remove 4,000 cubic yards of sand, gravel, clay, or similar material per hour to a distance of 700 feet. The earth is cut up and mixed with water by revolving trepans, until it is of a consistency that can readily be forced up by two powerful steam pumps of 1,428 horse power each. An electrical plant on board provides light and runs several small motors for the more delicate parts of the machinery. The dredge is 214 feet 6 inches long, 61 feet 6 inches wide, and when ready for work, *draws 4 feet 6 inches* of water. It can excavate a channel nearly 80 feet wide and 14 feet deep at one cutting. The fuel used is naphtha of which in full duty, about 1,200 gallons per hour is consumed. Tanks are provided that hold sufficient fuel to run at full pressure for twenty-four hours.

Buried Forty Feet Deep.

Between Edinburgh and Portobello, Scotland, stands a handsome monument with a singular history. It is a gigantic tomb, built in a massive, classic style, richly moulded and elaborately carved, with a beautiful carved marble frieze, representing the song of Miriam and the destruction of the Egyptians in the Red Sea. This large monument covers the remains of a great antiquary, and the owner of the largest libraries in the land—Wm. Henry Millar of Craigentinnie, a member of the Society of Friends. His father was a wealthy merchant in Edinburgh, and there was always some mystery about the son. It was thought by some that he was a woman from his clear voice, slender figure, and beardless face. Be that as it may, no one was allowed to touch his body after death but those immediately concerned, and by his own command he lies buried forty feet deep beneath this massive monument.

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South African Blue Asbestos.

Mr. H. F. Olds read a paper on "Blue Asbestos" before a recent meeting of the English Institution of Mining and Metallurgy. Mr. Olds said:

Blue asbestos is a variety of that mineral found only in South Africa. It occurs in Griqualand West, and is mined over an area of 30,000 acres. It differs from the other varieties of asbestos, such as the Italian, Canadian, or Russian, not only in that it is blue in color, but in being considerably lighter. The asbestos is found in veins, seldom less than two, or more often 4 to 5 inches wide, formed of closely compacted parallel fibres, which run from wall to wall of the vein without break or fault. The grain is very fine, and even in the rough state the fibres are singularly distinct. Several veins are found, always in regular extent, and the fibre always lies at right angles to the sides of the deposit. The enclosing rock is a dark brown shale. The fibres are somewhat elastic, and easily separable by the fingers. The character of the rock varies considerably; some places are soft and some hard; the better quality asbestos occurs in the hard rock. Its color is a peculiar lavender-blue, and is caused by the large proportion of protoxide of iron it contains. Its composition is given as:

Silica	51.1
Protoxide of iron	35.8
Soda	6.9
Magnesia	2.3
Water	3.9
	100.0

The present output is over 100 tons per month, and there is apparently unlimited capacity for development and increased turn-out as the demand for it increases. Native labor is employed under European supervision. Very little skilled labor is required, the mining being mostly surface work, or by shallow adits driven in the sides of the hills. The smallness of the cost at which the article is obtained forms a striking feature, being only £5 per ton of 2,000 lb. It has most of the qualities of white asbestos. It is uninflammable, rot-proof, and unaffected by atmospheric influences, and is a non-conducting material. It is stronger than the ordinary asbestos. In "cobbing" it breaks away from the matrix rock with a clean fracture, and without any fragments of the latter adhering. The wool is capable of being spun into very fine yarn, of great tensile strength, which can be woven into netting, twine, ropes, and cordage of all kinds. A composition is also made from the blue asbestos for rendering cement and other materials unattackable by acid liquors or vapors.

Emerald Mining in Russia.

The "Novoe Vremia" of St. Petersburg has the following interesting account of emerald mining in Russia: Emeralds, some of which are very fine, are found in the district of Ekaterinburg, along the banks of the Tokova River, about 52 miles from the capital of the district. Mining for this precious stone commenced in 1841, and at the beginning gave very good results. The first emerald was found by a peasant named Maxim Kojevnikow, in 1839, while he was examining the roots of a tree which had been uprooted by a storm. It is pretty certain, however, that discoveries of the same kind had already been made in 1669. It is even possible that finds had been made prior to them, as the Czar Boris Godounow presented the Venetian engraver, Francis Ascentini, with a sable fur and 100 ducats for having cut a large emerald for a ring. The finest emeralds were found when these stones were being mined for the account of the government. During this period, that is up to 1862, 5,600 poods were extracted. The government afterward farmed out the mines to private parties, who were not successful. The emeralds of superior quality have been found near the surface of the soil, while those found in deep ground were of inferior quality.

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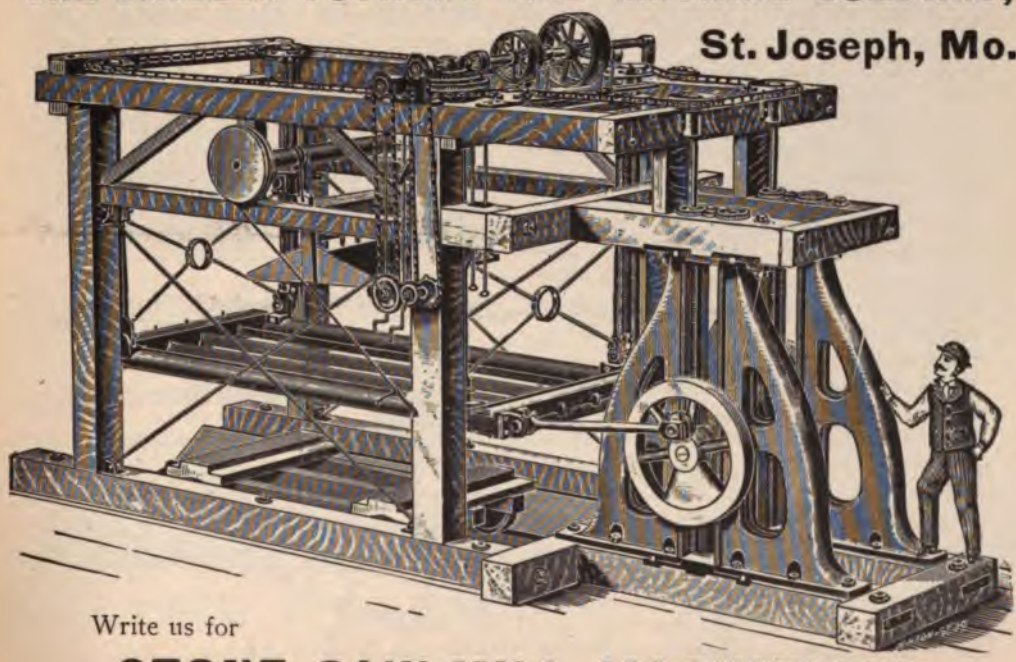

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A Legal Decision on Defective Mortar.

"The Architect and Contract Reporter," of London, quotes a decision of the English courts that will have an interest for builders everywhere. The paper says: "The risks from using defective mortar are numerous, for local authorities have in most places absolute power for dealing with it. A decision which was given this week by Mr. Justice Bruce in Smith vs. Johnson reveals that a building owner can also have his remedy against a contractor who is not careful in using such mortar as is considered necessary for safe building. The plaintiff contracted with the defendant for mortar which was to be used in the extension of a dormitory attached to a lodging-house in Whitechapel after the completion of the work. The plaintiff was ordered to take down and rebuild the dormitory because the mortar did not correspond with the requirements of the Building Act. According to the by-laws the mortar to be used must be composed of freshly-burned lime and clean sharp sand or grit without earthy matter in the proportions of one of lime to three of sand or grit. The dormitory was rebuilt as ordered. Then the plaintiff sought to obtain from defendant the money expended on the work as well as a sum for loss of rent. It was maintained that the quality of the mortar could not be detected because it was in a wet state. Counsel for defendant maintained that when the contract was made it was not understood that if the mortar was unsuitable it would be necessary to take down and rebuild the dormitory. Besides, the plaintiff should have rejected the mortar when it was supplied. Plaintiff's counsel held that the defective quality of the mortar could not be ascertained until it was used, and as the rebuilding was the result of defendant's acts, he must be held liable for the cost of the rebuilding. Mr. Justice Bruce considered that, according to the evidence, as the mortar was in a wet state, no reasonable diligence on the part of the plaintiff could have discovered the defects until the mortar was used. The plaintiff was therefore entitled to recover the expense of pulling down and rebuilding, as well as damages. His Lordship assessed the amount at 101*l*. The case is novel, and we hope it will compel builders to give more attention to the ingredients of mortar."

Canadian Mineral Production.

According to the official returns just issued, the mineral production of the Dominion for the year 1898 was $37,757,197 in value, showing an increase of some $10,000,000 over the previous year, and $27,000,000 over 1896. The yield of gold for the first time heads the list, representing $13,700,000, distributed as follows: Yukon district (partly estimated), $10,000,000, and other parts $3,700,000; silver, 4,434,085 oz. of the value of $2,583,298; nickel, $1,820,838; copper, $2,159,556; lead, $1,206,399. Coal was mined to the extent of 4,172,655 tons, valued at $8,227,958; petroleum, 700,790 barrels, $981,106; asbestos, $486,227. Other important items were natural gas, phosphates, salt, mica, graphite, pyrites, mineral pigments, etc. It is anticipated that with the present activity the yield of gold, silver, nickel, copper, and lead will rapidly assume larger proportions. The output of iron is at present unimportant, although large deposits exist in nearly every province, especially in Nova Scotia.

Cement for Pavements.

Remove the earth to a depth of 18 inches, and then fill up to a depth of 12 inches with large stones, and on top of these lay a bed of concrete 4 inches thick, made of one part Portland cement and six parts of stone chip and gravel, and on top of this lay 2 inches of a cement made of one part Portland cement and two parts of fine sharp sand. Lay this on up to the surface of the ground, and float the surface of the cement as considered necessary. To give a finish, line off into regular blocks.

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Workmen's Dwellings in Germany.

The American consul at Chemnitz writes that there is a movement on foot to furnish workingmen with better dwelling places in Germany. At present they are crowded into buildings which often look like barracks. The proposed houses will be built upon plots of ground about 16½ feet wide by 102 feet deep, thereby allowing for a front yard for flowers and a back yard for a vegetable garden and shed, the latter for the keeping of poultry or some domestic animal. The houses will contain five rooms. A parlor and kitchen will be on the first floor, the parlor containing a porcelain stove and heating pipes, and the kitchen a wash boiler and stove. The three bedrooms on the second floor will easily hold five or six persons, and can be made to accommodate ten. In the largest an iron stove will be placed. A pump will provide water where the city waterworks do not extend to the house. The cost of such a house and plot of ground when a number are built at a time will be between $850 and $950. It will let for about $45 a year—that is for the same price the workingman has to pay for two rooms in the barrack-like tenements of the large cities.

Back-to-Back Houses Forbidden in Leeds.

The Local Government Board of Leeds, Eng., has refused to sanction the erection by the corporation of that city of back-to-back houses in a recently condemned insanitary area. This decision, says the Leeds "Mercury," comes as a great surprise, as the deputation who recently waited upon the board's representatives in London returned to Leeds feeling confident they had made out such a strong case that the Local Government Board would make an exception in their favor and grant their request. But the Local Government Board have preferred, it seems, to stick to their general rule and prohibit such structures. The matter, it will be remembered, has reference to the clearing of the York street insanitary area. In that part of the city the corporation have received permission to demolish property which now provides shelter for 3,800 people on condition they provide new and conveniently situated dwellings to accommodate 2,000 of the displaced tenants. The sanitary committee, after lengthy deliberation, came to the conclusion that through houses could not be built to let at anything like the small rental the displaced tenants have been in the habit of paying. Further, they objected to the construction of flats, as they thought such premises were too much like barracks and too little like homes. They felt they had but one course left, namely, to provide the accommodation required by the erection of well-ventilated back-to-back houses. The Local Government Board's decision naturally places the committee in a dilemma. The expense of building through houses would be considerably beyond their anticipated expenditure on the scheme, even if they could obtain the necessary land for their requirements, which is doubtful. Their only way out of the difficulty seems to be the provision of flats. The deputation who recently inspected such structures at Glasgow came away with a very poor opinion of them. The resources of architecture, however, are by no means exhausted, and possibly some more acceptable dwellings may be devised than those at Glasgow.

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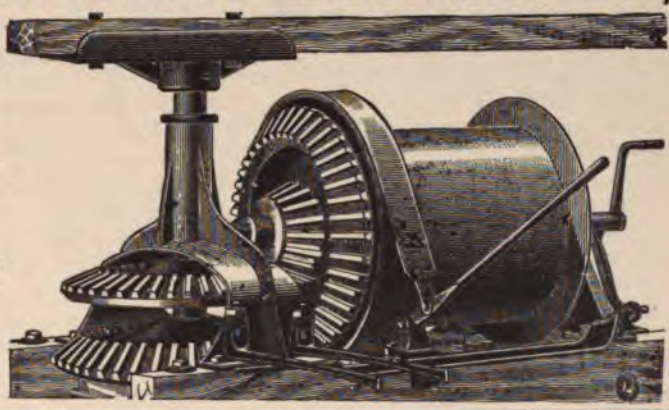

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Power Transmission for Underground Pumping.

In a paper read before the Association des Ingénieurs de Liége, Mr. Paul Habets comes to the conclusion that underground pumping engines, whether worked by steam, hydraulic power, or electricity, are nearly equivalent as regards the consumption of steam. Methods with gearing are, however, more economical whenever a pumping engine is laid dwon of greater power than that actually required under ordinary circumstances, in order to provide for an increase in the quantity of water, in which case the pump does not work continuously, and, if it be driven directly by a steam engine, its rate of consumption will increase in inverse proportion to the actual time it is at work. The advantage of reduced consumption, with suppression of the disadvantages caused by underground steam pipes, often compensates for the higher first cost of geared pumping engines. Hydraulic transmission has the advantage of great simplicity in the p'ant and its maintenance. The steam consumption of slow running compression engines, which may be fitted with very perfect valve-gear, may be reduced below 16½ lbs. per horse-power per hour; and with compression engines not consuming more than 14¼ lbs. per indicated horse-power, the consumption by the hydraulic pumping engines will be less than 22 lbs. per h.p. in water raised. Electricity requires motors of high speed, or of moderate speed if the generating dynamo be driven directly, while they are of short stroke and often less perfect as regards their valve-gear; but otherwise the generating dynamo should be driven by belt or rope, which is not, however, so favorable as regards the general useful effect. The management of dynamos would appear to be more delicate than that of hydraulic engines; but, on the other hand, the transmission of current in the cables is more economical than that of water under pressure in the pipes, while cables are more easily laid than rigid pipes. Electricity, therefore, is better suited for long distances, while more readily lending itself to working appliances of all kinds; but the special conditions of each case will decide which means for transmitting power should be adopted.

Advantages of Railway Structures of Concrete.

That concrete possesses many advantages in the formation of railway structures is being more generally appreciated from year to year. These structures, says Mr. F. G. Jonah, in his paper read before the Canadian Society of Civil Engineers, are particularly well adapted for use in the construction of new lines of railway, owing to the comparative ease with which the material for making concrete can be transported, as against heavy stone work. The use of derricks for loading and unloading material and specially constructed wagons for heavy hauling are not necessary in concrete work, and as it can be made with cheap, unskilled labor, a great saving in the wages of the force employed is thus effected. These culverts of concrete have a decided advantage over cast iron pipes on new works, owing to the great cost of transporting the pipes; but for renewals on old roads, cast iron pipes up to 5 ft. diameter are excellent. They will be much safer from wash-outs, however, if the ends are protected by wings, for which nothing is better than concrete. In the construction of culverts wooden forms are necessary for the work above the bottom or pavement line. The forms are practically molds into which the concrete is dumped. They should be made of lumber not less than 1½ in. thick, dressed on the side next to the concrete. If carefully used, one set of forms will serve for a great many culverts. For that portion of the culvert which is in the ground, including the back of side walls, the earth should be carefully excavated to the exact form of the culvert. Any irergularities will represent a waste of concrete. In putting the concrete in place, care must be exercised in tamping it thoroughly, to insure a close contact with the forms. If this is not done, the work will present a honeycomb appearance when the forms are removed. Forms should be left standing in place until the concrete has partially set.

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I AM open for an engagement by the year with good reliable firm as Manager or Foreman. Am an Eastern man conversant with every part of Granite and Marble business in Monumental and Building. Am practical general workman; A1 letterer. Have sold work to the better class of trade. Can work men to an advantage. Understand machinery and pneumatic tools. Can read plans, make working scale and elevation drawings. Well posted on buying at quarries. Have been with some of best firms. Am sober and reliable. No references will be furnished, but will work on trial and will guarantee satisfaction to any firm requiring the services of a hustling, competent man. Address A. K. N., care of STONE.

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FOR SALE OR LEASE—A fully equipped stone-yard at West Superior, with everything ready for business—dockage, switchage and paved street. Outlook for business never better. A fine opportunity. For particulars address ADAMANT MANUFACTURING CO., West Superior, Wis., Milwaukee, Wis.

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FOR SALE OR LEASE.—Quarry of the Rock River Brownstone Co., near Marquette, Mich. Will sell or lease this property on a royalty. Machinery for operating on the premises. Correspondence solicited. Address W. I. BROTHERTON, Bay City, Mich.

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Antique Cipollino Marble, of the finest quality,

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As a Decorative Material.

COLOR:

Dark grayish purple ground, interlaced with a net work of red and white veins.

CAN BE OBTAINED IN BLOCKS OF LARGE SIZE.
TAKES A BEAUTIFUL POLISH.

It is quarried in Devonshire and shipped F. O. B. Bristol, by

ARTHUR LEE & BROS., LTD.,

Marble and Granite Merchants ....

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The Stone Trades.

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See Classified Ad. Column.

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We make and carry the most complete and best assorted stock in America. Our goods are recognized as the standard of quality. They all bear our trade mark and are warranted by us. Our prices are reasonable. Our lavishly illustrated catalogue minutely and correctly describes our goods. It contain much valuable information, and is sent gratis on application.

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Stone of all sizes in the rough, and sawed slabs always in stock. Orders for stone sawed to dimensions promptly attended to.

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A GROUP OF MARBLE MONOLITHS.

STONE

VOLUME XVIII. MAY. NUMBER 6.

WHAT A QUARRY MANAGER SHOULD BE.

I WISH to address a few words to those who contemplate going into the quarrying and stone-cutting business, based upon a considerable study of men and methods. Although I have written before on this subject for STONE, recent instances that have come under my observation give an added point to what I have to say. Evidently we are at the beginning of a prosperous period in the stone business and there will be many new ventures in this line of industry. The past experiences of others, therefore, is a fruitful subject for contemplation, and may lead to the saving of money. Warning and advice of a general nature count for little compared with concrete examples, and so I will take the liberty of recounting in brief the history of two companies that made blunders resulting in their failure. The first of these was in the city of ———. It was organized under excellent auspices, and went into the furnishing of building stone and crushed stone for the trade. But the company took a clerk out of an insurance office, and made him their general manager. The result might have been foreseen from the beginning. In three or four years they sank not less than $50,000, to the surprise of no one who saw their methods. Another case was near the city of P———, where the company took a boy out of their office and made him the general manager of a marble quarry and stone-cutting business. The end was even more disastrous than in the first instance. The company got gradually deeper and deeper into a hole, until there was a failure to the tune of $200,000. I have in mind another company that is still operating, but that is bound to go to the wall, unless they make a radical change at once. Three men with money but little or no experience bought out a quarry, and made one of themselves general manager. This man, coupled with his entire ignorance of the stone business, has not even learned the virtue and necessity of sobriety. That their future spells failure, one may be sure.

The quarrying business consists of far more than the mere breaking of stone from the earth. In most industries it is universally recognized that a manager requires special and technical knowledge and long training. Why there is not the same respect for so complex a business as quarrying, I can-

not imagine. Let me state, in brief, what I consider the requirements for the general manager of a stone business, where quarrying and stone-cutting is done—and to be successful, stone-cutting must be carried on in most quarries in order to work stone that is not profitable to ship in large blocks. In the first place, the manager must be a thoroughly practical stone-cutter of wide experience, so that he can tell at a glance what will pass inspection. There is nothing more demoralizing than for workmen to know that their manager cannot properly judge their work. Let them once be able to say, "Oh, he doesn't know anything about the trade," and his usefulness is gone. In addition to the above the manager must be a good judge of human nature and be able to control and manage a large force of men. He must also be a practical geologist, so that in directing the quarrying he can take advantage of every natural condition. He must be thoroughly familiar with plans of every class of masonry and be posted on the values of all cut stone and the cost of setting. In fact, he should so understand masonry that he can contract for the work complete in the walls, when so desired, as is required in many cases of bridge masonry and public buildings. Much depends upon this knowledge in successful competition.

Above all, he must be a man of unimpeachable integrity, strictly temperate in his habits, so that he commands respect wherever his business calls him.

J. B. GORDON.

Roscoe, N. Y.

MODERN APPLIANCES IN QUARRIES.

THE huge beds of stone upon which the two magnificent palaces of the Champs Elysées are to be erected begin to make their appearance above ground. These two buildings will border the "Grande Perspective Nicholas II." at the Universal Exhibition of 1900. How will it be possible to construct so speedily these imposing monuments destined to remain after the Exhibition among the architectural beauties of Paris? We can readily understand, says a London exchange, how the architects, men of undoubted talent tested by numerous competitions, to whom the work was entrusted, imagined, studied, and planned these palaces with marvellous rapidtiy; but the materials themselves, the stones which form the bulk of the work, how can they be obtained in time, drawn in huge blocks from the quarries? Here is a very interesting object lesson, in which is revealed the power given to human labor by mechanics with its admirable utilization of forces. It is by the cutting, transport, and piling of huge blocks, that the successive stages of civilization have marked the extent of their grandeur. Are not the obelisks and pyramids a cause of admiration and wonder even to people of the present day? How was it possible for pure manual labor, even when carefully distributed, disciplined, subjugated, to hew

those gigantic stones and then move them into their final resting-place? Important works have been written on this subject, from which it appears that the inclined plane and the wedge, no less than patience and length of time, contributed to remove these difficulties. But fundamental documents are too frequently denied to seekers; perhaps they were lost, to our deep regret in the famous and silly destruction by fire of the famous library at Alexandria. The present generation has consequently been obliged to begin all over again. Very fortunately, steam and electricity have given it perfectly new means of action of such power as to be able to rival the buried secrets of ancient engineers.

A striking example is furnished in the working of quarries, where electricity, now co-operating with the steam, wins victories of power of great value. Work must be smart in the cutting of a bed of stone in quarries. The architect who has ordered the ashlar and arch-stones is always in a remarkable hurry. Beside, one has to work in the open air amid the dust in fine weather and under the pelting rain in bad. The steam engines scattered about the quarry were often injured by such a state of things; they became clogged, suffering from a kind of engine rheumatism, afflicted by untimely condensations, a kink of pulmonary apoplexy, and uttering heart-rending groans, not, however, stone-rending.

With the pliant electric conductors all these inconveniences vanish in many cases. In the great quarries at Euville, for example, for the work of extraction, the machines which cut the stones are electric, the workyards are lighted by electricity, and water is raised by this same means to a height of sixty meters to feed the boiler of the little steam motor, which is situated at the end of the big rolling bridge and raises the stones through space. From an already long experiment it is estimated that a great final saving is thus obtained.

In the quarries at Hainault, also famous, there is a rolling bridge of sixty metric tons-power which raises the biggest blocks. It is worked by steam, but illuminated by electricity, and served continuously by pumps, windlasses and electric cranes. The annual production of a quarry exploited in this way is estimated at 20,000 cubic meters of grainte. We may also mention the instructive case of the Soignies quarries. When boilers and special motors were employed for the various machines situated in different parts of the workyards which are about fifty-two hectares in area, the consumption of coal was four to five kilogrammes per effective horse-power. Since adoption of electricity the consumption of coal fell below one kilogramme per horse. It is a result not to be despised, and which demonstrates the utility of classing motive power. Let me add that, thanks to these powerful electric machines, the time requisite for extraction of stones and their employment has thus been greatly reduced. To build a big monument, palace, or imposing edifice of any kind, we had formerly to reckon on long delay in extraction, but circumstances change. It is quite a different affair to dry a stone which for months has been subjected to the inclemency of the weather, and that which is removed and placed under shelter in a few days.

It is to this powerful and improved extracting plant that the Exhibition of 1900, being now prepared on a scale of incomparable grandeur, will be

indebted for the sudden appearances of palaces above ground, recalling to mind the mythological legend of Orpheus charming the animals, rocks, trees, etc.

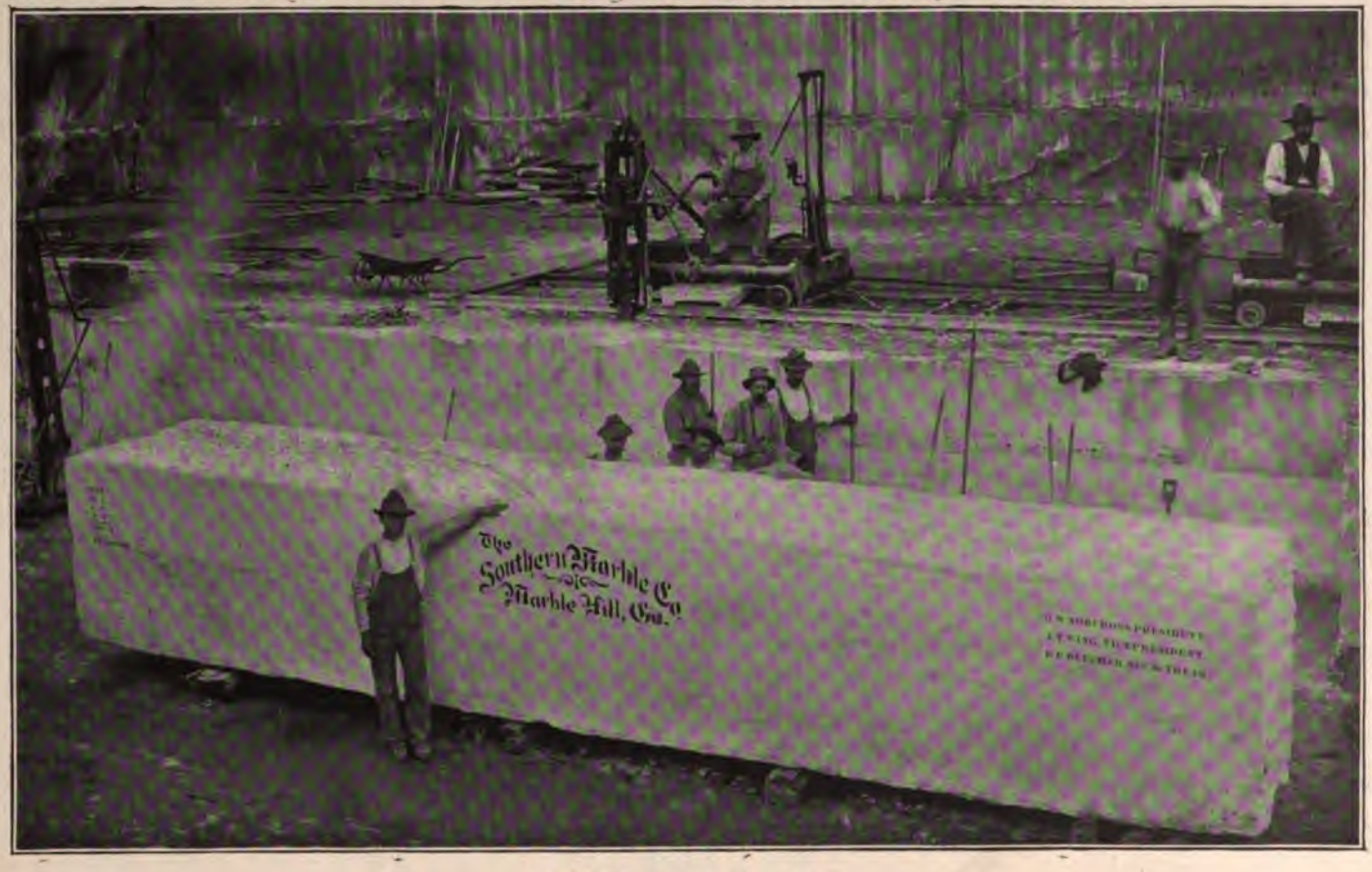
In fact we here find a reply to the question made by Henri Heine—Had not Nature formerly a sensibility similar to that of man, and perhaps more? The inspiring power of Orpheus, we are told, led away trees and rocks in a dance. Is such a prodigy possible in the present day? If Henri Heine were conducted by one of the architects of the future Exhibition through the yards where the marvellous work is being executed, he would no doubt exclaim, all poetical scepticism conquered, "The prodigy has happened."

A REMARKABLE ACHIEVEMENT IN QUARRYING.

IN the April number of STONE was given an account of the quarrying of one of the largest blocks of marble taken from the earth during modern times. This was gotten out by the Southern Marble Company, of Marble Hill, Ga., from its noted quarries in Pickens County. The block of marble was almost pure white, and measured 27 feet 2 inches in length by 4 feet 4 inches by 4 feet 3 inches, a grand total of 500 cubic feet and 4 inches. The weight of the monolith was 100,066 feet. This was only one of four blocks all of them about the same size. At the request of the publisher of Stone, photographs of these great blocks, as they lay in the quarry, were taken, and two of these are reproduced herewith. They make a most interesting exhibit.

Two of these monoliths have recently been shipped to Norcross Bros., at Providence, R. I., where they will be shaped into handsome columns to be used in the building of the State Savings Bank, at Detroit, Mich. The transportation of such huge blocks of stone was a problem of some moment. A special one-hundred-thousand-pound-capacity flat car was secured from the Pennsylvania Railway. This car is a finely constructed affair of steel and iron, and runs on sixteen wheels. The marble shaft occupies the entire car. The passage of this ponderous and unwieldy load over bridges and trestles and around curves is a matter of anxiety and care.

The marble from this Georgia quarry has met with general favor for fine buildings in all parts of the country. One of the latest and most stately structures in which it figures is the Rhode Island State House. It will be seen from the photographs that the nature of the quarry lends itself particularly to the getting out of blocks of unusual size. Previous to the present achievement, however, the largest block quarried in Georgia was on exhibition at the Cotton States and International Exposition, and weighed only 45,200 pounds, or less than half the size of these shafts.



A MONSTER SHAFT OF MARBLE.

What is known as Georgia marble is quarried almost entirely in Pickens county. The quarries of the Southern Marble Co. are located four miles east of Tate, a station on the Atlanta, Knoxville & Northern Railway. These quarries were opened in the year 1885 by Messrs. Miles & Horne, of Atlanta, who were then building the Georgia State capitol. Four years later, Messrs. Norcross & Wing, of Worcester, Mass., secured the property and most of the development of the quarries has been under their direction. No less than four quarries have been opened, the last one, Quarry No. 4, in 1893. This is the one from which the largest quantity and best and purest marble has been taken. In order to ship the blocks, a gravity road has been built to the quarry. It is from this quarry that all of the marble has been taken that was used in the construction of the State Mutual Life Building at Worcester, the Corcoran Art Gallery at Washington, a great part of the marble used in the National Library, and 75 per cent. of that used for the Rhode Island capitol. Still another quarry has been opened about one hundred feet from this, and from the new one will be taken the balance of the marble needed to finish the Rhode Island capitol. One feature of this building will be almost unique, a large dome of marble which can be matched only by the far-famed dome of the Taj Mahal, at Agra.

The cutting out of such huge shafts as those depicted is a task of such magnitude, that it can be appreciated only by a practical quarryman. A channeling machine was used to cut a narrow channel the full depth and length of the block. Along the lower side and the ends were drilled by a gadding machine, a series of holes close together. In to these were driven steel wedges or plugs until shaft was gradually lifted up and broken free from the surrounding mass of marble. It was then pried up by bars and cannon balls were placed under it to serve as rollers so that it could be shifted at will.

A chemical analysis of the marbles from the quarries of the Southern Marble Company, made by Prof. L. P. Kinnicutt, of the School of Technology, Worcester, Mass., gave the following result:

Carbonate of Calcium	98.96
Aluminum and Iron Oxides	.22
Insoluble residue	.61
Loss and undetermined	.08

The crushing tests of the marble is as follows :

NAME.	Compressed Surface in inches.	Actual Crushing Load in lbs.	Compressive Strength per sq. inch in lbs.	Reduced to correspond to pressure on sq. inch on 2 in. cubes in lbs. per sq. inch.
Southern No. 1 ..	.99 x 1.00	11,300	11,414	13,696
Southern No. 2 ..	.99 x 1.00	10,900	11,010	13,212
Southern No. 3 ..	.98 x 1.00	10,800	11,020	13,224

The specific gravity of No. 2, was 2.734, and its weight per cubic foot in pounds, 171.8.

The absorption tests of one inch cubes gave this result.

NAME.	Weight after drying 24 hours.	Weight after remaining in water 72 hours.	Approximate Percentage of absorption.
Southern No. 1 ...	46,170 grammes.	46,200 grammes.	.006 per cent.
Southern No. 2 ...	44,440 grammes.	44,475 grammes.	.008 per cent.

TWO AMERICAN DEPOSITS OF FLUORSPAR.

MR. E. E. SQUIER, JR., has written a paper for the "Engineering and Mining Journal" on "Fluorspar Mining." Mr. Squier says: Fluorspar occurs in the United States only in Crittenden County, Kentucky, and Hardin County, Illinois. It is found in veins in connection with limestone and yellow clay, a small amount of lead, calcspar and feldspar being present. The fluorspar found in Kentucky is a pure white massive variety, and is found in veins ranging from 6 to 30 feet in width and varying greatly in length. The largest vein so far discovered in the State is owned by the Fluorspar Company, of St. Louis, Mo., and is known as Mine No. 1. It is situated on the side of a hill and runs almost due north and south from 25 to 50 feet below the ridge. It has been prospected a distance of over 1,200 feet, and the width varies from 15 to 30 feet. In this case the spar is found from the grass roots down.

The main shaft on this vein is 13 feet square and has reached a depth of 96 feet. At this level two drifts, each 6 feet high by 7 feet wide, are being run north and south along the vein, cutting through an almost solid mass of pure white fluorspar. Heavy timbers are necessary to support the roofs. When a drift has been run far enough, a narrow track is laid, upon which small four-wheeled flat cars are run. The buckets are placed on these, and when loaded at the end of the drift are wheeled to the foot of the shaft. They are then hoisted to the top by a horse power whim, so arranged that while one bucket is being brought up another is going down.

Upon reaching the top the bucket is put on another car, wheeled to the sorting and cleaning sheds, dumped, and returned for another load. At the sheds the spar is taken in hand by the sorters, hackers, screeners and barrelers. The large pure white lumps from 5 to 150 lbs. in weight are first selected and turned over to the hackers, who chop off with hatchets the small amount of dirt adhering. It is then graded as No. 1 pure white lump fluor-

spar and is used for the manufacture of hydrofluoric acid and for grinding for the use of glass manufacturers, enamelers, etc. The slightly off or mixed colored lumps are also separated and cleaned, and known as lump fluorspar. This grade is used by steel manufacturers.

After taking out the large lumps the spar passes to the screeners, who separate the fine or gravel spar from the crushed or small lump fluorspar by the use of coarse screens. The crushed fluorspar is passed to the barrelers, who grade it into Nos. 1 and qualities, according to color, and at the same time barrel it. When filled the barrels are headed up and loaded into wagons or placed in the warehouse. Barreled fluorspar is also used by acid makers, iron and steel manufacturers, blast furnaces, foundries and furnaces. Very little fluorspar of any grade is kept at the mines; it is hauled to the railroad and loaded on the cars or stored in the warehouse and on platforms as fast as it is taken out.

The demand for all grades of fluorspar has been steadily increasing during the past year, as the iron and steel makers are beginning to realize the benefits derived from its use.

Besides the above described Mine No. 1, the Fluorspar Company is developing mines No. 2 and 3, which bid fair to equal No. 1. The company also owns or controls 2,000 acres of mining lands, which, although not now worked, are known to contain a fine grade of fluorspar.

In Illinois the fluorspar is found under the same general conditions as in Kentucky. It is also of the massive variety, but is of a mottled color and not as pure. The Fluorspar Company owns or controls extensive deposits at Karber's Ridge, Cypress Junction, and Shawneetown, in Illinois, which are worked on the same plan as in Kentucky.

BROOMIELAW BRIDGE, GLASGOW.

This bridge has seven segmental arches, the center span being 58 feet 6 inches and having a rise of 10 feet 9 inches, the two adjacent ones 57 feet 9 inches span and 10 feet 5 inches rise, the next ones 55 feet 6 inches span and 9 feet 8 inches rise, while the shore spans are 52 feet 3 inches. The piers range in thickness from 8 to 9 feet and have octagonal ends, supporting octagonal counterforts, which carry the pedestals and lamps. The bridge has two sidewalks and a roadway with two car tracks, making up a total width of 58 feet in the clear between parapets. The arch ring is composed of uniform ring stones with chisel draft on all edges, while the spandrels are paneled. The balustrade has turned balusters and a pilaster over each kestone. The piers and abutments are of freestone, while the face work of the arches and spandrels is of granite.

THE BROOMIELAW BRIDGE, GLASGOW.

The bridge was designed by Telford, who is credited with having built upwards of eleven hundred stone bridges, having over twelve hundred arches.

The foundations were built in cofferdams having a five or six-foot puddle chamber. Piles were driven for the foundations, cut off to a level and capped with grillage platforms on which to lay the masonry. The paving for the roadway is laid upon concrete, the sidewalks are of flat stone, the 12-inch curb of granite has the angle rounded off, while the gutter, also of granite, is 14 inches wide and has a triangular channel cut in it, 8 inches wide and 4 inches deep. "F."

THE PAVEMENTS OF PARIS.

CONSUL-GENERAL GOWDY, in the advance sheets of the Consular Reports, says:

The paving of the Paris streets and boulevards dates as far back as the end of the twelfth century. In the year 1184, Philippe Auguste commenced replacing the beaten ground by stone paving. The localities first treated were the square of the Chatelet, the routes of St. Antoine, St. Jacques, St. Honore, and St. Denis. It is considered that the department of streets and alleys, as we would designate it in the United States, is one of the most important in the city administration.

The streets of the city of Paris are supplied with four different classes of paving, viz., stone, macadam, asphalt and wood. There are some streets still remaining of ordinary earth composition, but they were originally the property of individuals, and are fast being replaced by other compositions, as they come under the control of the municipal authorities.

On Jan. 1, 1896, the total amount of stone paving was 1,410,300 square meters (1,686,719 square yards); in 1897, 1,396,400 square meters (1,670,094 square yards). The decrease between the years was accounted for by the replacing of this paving by wood.

In 1896, the total surface of asphalt paving was 357,650 square meters (427,749 square yards); in 1897, 372,950 square meters (446,048 square yards) —an increase of 15,300 square meters (18,299 square yards).

In January, 1896, the total surface of wooden paving was 907,400 square meters (1,085,250 square yards); in 1897, 1,120,000 square meters (1,339,520 square yards).

On January 1, 1896, the total surface of earth roads was 40,750 square meters (48,737 square yards); in 1897, 40,500 square meters (48,438 square yards).

COMPARISON OF PAVEMENTS.

Nature of paving.	When laid down.	Cost per squnre meter.		Cost of maintenance.		Average duration.
		Francs.		Francs		Years.
Stone	Undetermined....	18.00	$3.47	.74	$0.14	30
Macadam	Undetermined....	6.00	1.16	2.55	.49	5
Asphalt	1855.....	16.50	3.18	1.30	.25	15
Wood	1881.....	18.50	3.47	1.50	.29	8

The paving stones are generally in block form, 16, 18, or 20 centimeters (6, 7, or 7.9 inches) high, of hard stone. Paving blocks of porphyry are not used now, being considered too slippery. The cost of putting down this paving includes the sand bed, from 15 to 20 centimeters (5.9 to 7.9 inches) thick. Its great fault is the noise it produces. It was estimated that up to 1897, the stone paving of Paris had cost the city 110,484,000 francs ($21,323,412).

Macadam.—The cost of cleaning and watering is included in the price of maintenance of this paving. The cost quoted is for a depth of broken stones of 35 centimeters (13.7 inches), reduced to 30 centimeters (11.8 inches) by rolling.

The macadam paving had cost the city of Paris, up to 1897, the sum of 6,448,750 francs ($1,244,607).

Asphalt.—These roads have a foundation of 15 centimeters (5.9 inches) thick of mortar, called "beton," composed of lime, sand, gravel and water, and broken stones, over which is placed the layer of asphalt 5 centimeters (1.9 inches) thick after compression. The asphalt used in Paris comes from Ragusa (Sicily), de Mons (Department du Nord), and Val-Traverse (Switzerland). The asphalt, after having been heated, is transported while warm to the roadway, beaten down with hot metal stampers, and afterwards subjected to the cylinder rolling.

The principal advantage of asphalt is that it produces no noise. The objectionable features are its slippery condition in wet weather, and that it can only be used in level streets. It is chiefly employed in narrow streets, or where there is great traffic. Up to 1897, asphalt paving had cost the city 6,448,750 francs ($1,244,609).

Wooden Paving.—Wooden blocks 12 centimeters (4.7 inches) high and 15 centimeters (5.9 inches) long are placed upon a foundation of "beton," as described above. The blocks which have given the best results are from the pine trees of the Department of the Landes, and these are mostly used. However, on many of the main thoroughfares the pitch pine of Florida has been employed with marked success. Within a few years, trials have also been made with the hard exotic woods, such as the kauri and teak of Australia and Java, the liem of Anam, the stringy bark, etc.; but these trials have been of so recent a date that they cannot be used for purposes of comparison. It is estimated that up to 1897, the wooden paving of Paris had cost the authorities 16,386,027 francs ($3,162,503).

The maintenance department of the streets and alleys of Paris is com-

posed of 396 officials, including one chief engineer, 8 ordinary engineers, and 387 assistants, with a pay roll of 1,350,261 francs (260,600) per annum.

The city spends for the maintenance of the streets, 12,644,592 francs ($2,440,406); for sidewalks and alleys, 2,009,611 francs ($387,855); for cleaning the streets and alleys, 9,340,082 francs ($1,802,635), making a total expenditure for streets and alleys of 23,994,285 francs ($4,630,897). The figures as above given, include the salaries of the maintenance force.

The number of permanent workmen are: For maintenance, 1,902 for cleaning, 3,694; total, 5,596.

A LEADING FIRM IN THE MONUMENTAL BUSINESS.

THE publisher of STONE takes pleasure in presenting this month a sketch of the firm of Townsend & Townsend, of New York, one of the most widely known concerns in its line in the country. The firm consists of Messrs. Wm. C. and Edwin O. Townsend, and is the oldest one in the granite trade doing an exclusively wholesale and jobbing business of granite monuments and Italian statues. The firm supplies to the trade American granites from all of the noted granite centers, Barre, Vt., Quincy, Mass., Westerly, R. I., and Milford, N. H. Its facilities for furnishing all of the popular New England granites are second to none, and while it does not manufacture directly, the firm is nevertheless interested with several concerns that supply it with granite, and its relations with these firms are so close that it may be said that it practically manufactures the greater part of its American granites.

The second division of the business of Messrs. Townsend & Townsend is confined to the importation of all the finest grades of Scotch, Swedish and German granites, through its Aberdeen office, at 156 Market street, Aberdeen, Scotland. At this point the office is under the direction of a manager of many years' experience in the granite business, and by reason of this experience it is in a position to give to its customers and patrons the advantages of quick shipments and perfectly reliable goods. Messrs. Townsend & Townsend were, in fact, the first to import the Swedish granites into the

United States, and it was mainly through their efforts that what is known now to commerce as the Pearl granites were introduced to America.

Still another line of business followed by the firm is the importation of fine Italian monuments and statues. This is a branch in which Messrs. Townsend & Townsend take a particular pride. No stone in the world has a wider fame than the celebrated marble of Carrara, which for many centuries, almost since the dawn of classical history, has been recognized as the greatest of statuary material. The firm draws its supplies from one of the best of the Carrara quarries, and each figure as it is in the process of being manufactured, is carefully examined from day to day by an experienced man who is held responsible for the work being of the best quality, and of the finest execution. Each statue is turned out by an artist who is a professional sculptor. Reproductions from photographs is one of the specialties of the firm in this line.

Not content with this diversity of business, Messrs. Townsend & Townsend also import from their house in Scotland large quantities of iron shot or grit, used largely by the polishers at Barre, Vt., Quincy, Mass., and elsewhere. This is made from a superior quality of iron, and while it is expensive as to first cost, it is durable and consequently economical.

The handsome monumental design which accompanies this article was patented on April 4, 1899. A photogravure of it can be obtained upon ap-

plication to the firm at the New York office, No. 156 Fifth avenue. The little cut, showing the group of three figures, represents a beautiful memorial furnished to a patron of the firm in Texas. It was cut from a single block of marble. The work of Messrs. Townsend & Townsend is to be found all over the country, many of the finest memorials in the leading cemeteries being of their production.

THE HIGH BUILDINGS OF THE ANCIENTS.

TO Professor Lanciani is due the credit of the discovery that there were building laws in Rome long before the Christian era, says a writer in "The Illustrated Carpenter and Builder," of London.

As the price of urban property increased the landlords were forced to build high, and 200 years before the time of Christ the height of Roman tenements became alarming to those having the care of the public safety.

There are frequent allusions among the Roman historians, orators and poets to the enormous height of the tenement buildings of Rome, but no definite figures are given until the days of Augustus, when a law was promulgated by the Senate which fixed the height of new structures at 60 feet on the street front, without making any allusion to the height of the rear. It is, however, known that in the rear these tenement buildings rose often several stories higher than in the front, so that from a distant height, as from the top of a temple which commanded an extensive view, a row of tenement buildings in Rome presented the appearance of a terrace—highest in the rear and descending by stories towards the front. This law of Augustus applied to new buildings, respect, then as now, being shown for investments already made. The number of stories on the street front of these Roman buildings was generally ten to twelve, with fourteen or fifteen in the rear. The lowest stories were 8 feet or 10 feet in height; but, from accounts given by the writers of that time, the stories appear to have gradually diminished as their height above the ground increased, so that the topmost tenants lived in quarters where very often they could not stand erect. That the stories were sometimes much less than 5 feet is shown by the discoveries in Pompeii, where in a house inhabited, presumably, by poor tenants, a story of 4 feet 3 inches has been discovered. This was a living-room, too, for in it were found all the articles which pertained to Roman housekeeping—cooking utensils, beds, stools, mirrors, combs, brushes, and other things which, with the bones of the family, furnished indisputable evidence that the rooms had been occupied. It is quite likely that there were *thousands of rooms* in the tenement districts of Rome that were no higher

than this Pompeiian tenement; and, indeed, more than one Roman poet alludes to the lodgings into which he must "creep," the word, perhaps, indicating not a figurative but a literal method of entrance. That the tenement houses of Rome towered at least 100 feet above the street in front and probably 125 feet to 130 feet in the rear is certain, for the promulgation of an edict limiting the height to 60 feet in front indicates that this height had been so greatly exceeded in so many cases that the public safety was believed to be imperilled. How many stories were contained in these tenements is conjectural, but if the upper stories were no higher than that of the house in Pompeii the Roman tenements may have contained as many or more stories than the modern office building.

The height of these Roman buildings was entirely irrespective of the width of the street. Modern building laws have more or less reference to the width of the streets on which the building faces, and to the isolation of the structure or its proximity to other buildings. The Berlin Building Act admits in residence buildings a maximum height of 36 feet if the street is of that width, and a greater height if the street is broader; the Building Act of Vienna allows 45 feet if the street is that wide, while the building laws of Paris permit a height in residence buildings of 63½ feet, provided the street is of that width. The Roman building law, however, had no reference whatever to the width of the street, and as most of the Roman streets were very narrow, the city, looked at from a height, strongly resembled a mass of houses with narrow trenches between. Many important thoroughfares did not exceed 10 feet in width; the widest streets in Rome were not more than 100 feet, while the side streets were often mere passageways, from 5 feet to 6 feet in width. With streets no wider than this, and with houses of which the upper stories projected farther than the lower, it was quite possible for the inhabitants of the topmost tenements to shake hands across the street, if the custom of shaking hands had been as much in vogue then as now. That the situation was greatly to the advantage of thieves, marauders, and night prowlers, is evident from the frequent allusions to the depredations of burglars, and ease with which a passage could be effected from roof to roof, even across the street. While providing an escape for night hawks, the narrow streets proved also the salvation of the tenement residents in case of fire. A city in which the houses were so closely packed together was extremely liable to extensive conflagrations, but when a tenement house took fire below the population simply climbed the stairs to the roof and, with such of their goods and chattels as could be easily transported, escaped to the roofs of adjoining tenements or across the streets to houses not affected by the conflagration.

The extreme height and overhanging stories of the Roman buildings were a source of danger to the citizens in more ways than one. There were many important thoroughfares in Rome that were always in the shade; only at high noon did a streak of sunlight find its way between the buildings to the pavement. The streets were thus always damp, for, although Rome was sewered and there was a penalty against throwing slops into the street, the city was none too cleanly, and there were frequent humorous allusions, among the poets and writers of odds and ends, to the misfortunes sustained

by pedestrians, who, while passing along the streets were deluged by buckets of slops carelessly thrown from upper windows. Pliny mentions a wedding which ended in a riot on account of the leading participants being thus besprinkled with filth—not of design, but through the carelessness of a housewife who lived in the eighth or tenth story and had no desire to work overtime in walking up and down stairs with her bucket. The narrowness and dirtiness of the streets explain the frequent visits of various forms of pestilence, which from time to time devastated the city; the black death, the plague, the mysterious visitations of unknown diseases, which from their symptoms appear to have been akin to cholera, yellow fever, and diphtheria—all these were indirectly chargeable to the high buildings and the damp streets.

There was another danger hardly less serious. Queer as it may seem to us in these days of gas and electricity, the streets of a city which certainly contained 2,000,000 and may have had 4,000,000 of population, were at night in the darkness of Egypt. Such a state of things presented singular facilities for the operations of footpads and highwaymen, and the frequency with which their operations were attended by murder is shown by the numerous epitaphs that have been discovered intimating that he whose ashes lay beneath was killed by robbers. Every householder, every tenant in a tenement house, had to look after his own security, and accordingly, the doors of residences at dark were barred, every window was secured by a strong iron lattice, and in tenement houses the street doors were fastened, and a common fund, raised by the tenants, was provided to secure the services of a watchman to look after the building. In the tenement structures which had a respectable class of tenants the watchman went his rounds through the building at regular intervals, but in the better class of houses there were generally two or more watchmen, and the one at the front door was chained, so that he at least would give proper attention to business through the night.

Little heed seems to have been paid by the Roman builders to the edict of Augustus, and from all accounts the houses in the tenement district rose higher and higher, for in the next forty or fifty years half a dozen edicts were promulgated on the subject, which would not have been the case had the first been obeyed. Nero did more for Rome than any monarch before or after his day. Nero has probably been the most abused individual of ancient times, and his wanton cruelties, the barbarity with which he persecuted not only the Christians, but all opponents, political or religious, his nameless vices, the murders of his relatives, chargeable to his account, all have combined to render him an object of detestation to succeeding ages. But, probably on the principle of "giving the devil his due," Professor Lanciani has shown that the merit of remodelling Rome was due to this monster in human form. If Laniani is to be believed, the great conflagration which destroyed Rome in A. D. 64 was the work of Nero's agents, and if the latest researches are to be credited, the work was done with such effectiveness that of the fourteen wards, three were completely burned, seven were almost totally destroyed, and the other four were more or lsss damagd. There seems, however, to have been method in the madness of the Emepror, for some historians assert that in spite of the extent of the conflagration not a single

life was lost, while others, admitting there were casualties, declare them to have been very few.

However this may have been, it is certain that as soon as the ruins had grown cold the entire working population of the city was given employment in clearing off the débris, transporting it to the Tiber, and erecting new structures. The imperial architects went to work and reconstructed the entire plan of the city. Without paying the slightest regard to previous lines, new structures were laid out as nearly straight as the nature of the ground would permit. Public squares, breathing spots, were located at convenient places in the tenement district, and a law was promulgated that no residence house should be higher than twice the width of the street. This seems to be the first reference among the Roman building laws to any proportion between the height of the house and the street. The changes proposed by Nero, had they all been carried, would have made Rome a city which for comfort, convenience, and safety was unequaled in ancient times, and not easily surpassed by modern cities. Every tenement house or residence building was to be isolated from its neighbors; wooden ceilings in the two or three lower stories were prohibited, the ceilings rested on stone or brick arches, wood being permitted only in the upper stories. Every householder was ordered to erect a wooden portico in front of his building, that passers-by might have shelter from sun and rain, while the width of the streets and the isolation of the buildings furnished a reasonable guarantee against future extensive disasters by fire.

Very soon after the promulgation of this law Nero left Rome on his musical tour of Greece and the provinces, and his death, in A. D. 68, put an end to the reforms which he projected. They were partially carried out, but his memory was so detestable to the Romans that even the excellent plans which his architects drew up for the reconstruction of the city were thrown aside because they were connected with the name of the most hateful tyrant who had ever occupied the throne of Rome. The old abuses returned, public squares were sold to speculators, tall tenements, with narrow streets again came into fashion, and such was the height of the buildings that one Roman poet mentions a friend who had to climb two hundred steps every night to get to his lodgings, while another alludes to a fire in a tenement which had reached the third story before the dwellers in the upper portions of the building became aware of its presence.

The next building law in Rome was promulgated by Trajan, and without respect to the width of the street. It forbade a height in new buildings of more than 70 feet on the street front, like the other building laws, making no allusion to the rear stories. The tenement evil in Rome was thus on the increase, and an explanation is found in the fact that in those days men were obliged to live close to their work. There was no rapid transportation which enabled the workman to live miles from the factory, and to travel back and forth to his home morning and evening. The workman must live within an easy walk of the place of his toil, so the tenement districts of Rome were all located in the manufacturing quarters, and, to state the case in a modern way, all the tenement region of Rome was one vast sweat-shop.

Rome was not the only ancient city with building laws; Constantinople

had them also. When the Emperor Constantine determined to erect his capital on the Golden Horn, the peninsula was separated from the mainland by a wall, and thus the limits of the city were defined by the imperial orders so that all might understand whether city taxes or country taxes were to be paid on property in the vicinity, for the difference between urban and suburban real estate was then as closely defined as now. As soon as the Emperor's intention became known, there was a rush of speculators from all parts of the empire to purchase property in Constantinople and vicinity, and within a year after the imperial proclamation setting apart the peninsula as the chief city the property had gone up 300 per cent. All the real estate within the wall which Constantine had erected as the limit of the capital was held by speculators and capitalists, who invested hoping to realize a very large profit. Their expectations were not disappointed, but the change of capital from Rome to the East produced a result which was not anticipated.

The price of land rose so high that sufficient rentals could not be realized from the buildings already standing, and capitalists sent to Rome for architects to erect tenement buildings. They came, and if any judgment can be formed from the result of their labors they must have come in considerable numbers, for in less than ten years after the announcement of Constantinople as the capital city the tenements of Byzantium rivalled the tenements of Rome. Constantine had fixed upon the top of the hill, the highest point of the peninsula, for his palace, but, to the intense disgust of the royal occupant, it was discovered that before the splendid residence of the Emperor was fairly finished, his view of the sea was cut off by innumerable tenements, which, standing on much lower ground, still rose high enough to impair the prospect from the royal palace. Constantine was not the man to put up with this sort of thing. He had spent too much money on his house to move, so a building edict was promulgated forbidding any tenement higher than 100 feet to be constructed, and also ordering those which exceeded that height to be reduced to the proper limit. Great was the outcry among investors and speculators, for it is said that from one block of buildings four stories had to come down. How high these stories were we have no means of knowing, but supposing them to have been only 9 feet, there must have been tenement buildings in Constantinople which exceeded 136 feet in height. Various emperors, after Constantine, endeavored to restrict the construction of high buildings, in order to retain a view of the sea from the imperial residence, but all in vain; the architects persisted in carrying the houses up to the legal limit, and whenever it was possible to disregard the statute it was disobeyed.

One curious case is recorded of evasion, showing that men in those days were as sharp as they are now in ignoring the spirit, while pretending to comply with the letter, of the law. Apothagos, a Canstantinopolitan, erected a row of tenements about half-way between the Golden Horn and the royal palace. The houses were of stone and brick up to the legal limit of 100 feet; above this there was erected a shanty structure of wood three stories in height. The imperial building commissioners objected and ordered Apothagos to pull down his superstructure, but he refused, alleging that the law *applied to* permanent, not temporary buildings; that the wooden superstruc-

ture was only temporary, designed for the use of his workmen until the interior of the house should have been fully completed. The commissioners persisted in their order for the removal of the wooden stories, when the stubborn Apothagos went to law and applied to the imperial court for a writ commanding the commissioners to abstain from disturbing his peace and damaging his property. Law then was what it is now, and as Apothagos secured good lawyers to plead his case, on one technicality or another the matter was kept in litigation for years, meantime the structure continuing an eyesore to the Emperor and Court. The matter was finally decided by the courts ten years after litigation had begun, and Apothagos was ordered to remove his wooden structure. But in the interval Emperor Leo II. died, and his successor, paying little attention to such matters, and the building law having been disregarded in many quarters, the wily Apothagos obeyed by tearing down the wooden stories and putting a brick and stone superstructure in their stead.

The Emperor Zeno, directly after his accession, in A. D. 474, undertook to reform the Constantinople buildings, and promulgated a building edict limiting all future tenement structures to 100 feet in height, provided the street in front was 100 feet wide. Constantinople then suffered as much from fire as it has done under the rule of the Turks, and it was after one of these great periodic conflagrations that the reform of Zeno was begun. The burned district lay to the north of the peninsula, and Zeno's architects, following the example set by Nero, disregarded all former streets and boundaries and laid out new avenues, straight from the top of the hill to the water, crossed at right angles by streets running parallel with the shore. The streets from the hill to the water were 100 feet in width, while the avenues crossing them were 60 feet, and just in front of the imperial palace a grand avenue 150 feet in width, leading straight to the water from the central palace gate, was projected. This portion of Constantinople was thus made regular, and it is the only part of the city that now has wide streets and avenues crossing at right angles, for ere Zeno could carry out his plan for rebuilding the entire city he died, and the scheme was given up.

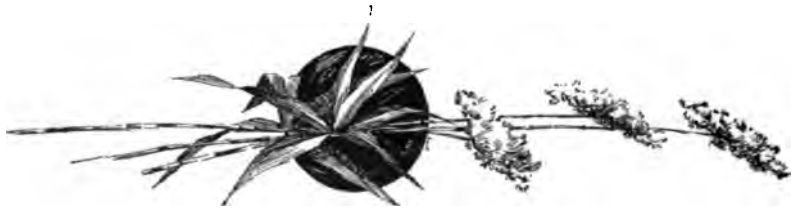
There is abundant evidence that high buildings, or at least buildings of a height that the ancients were not supposed capable of reaching, were to be found in almost every large city of antiquity. It is said by Herodotus that there were houses in Babylon of four stories in height, while the Carthage houses often exceeded six stories. The City of Tyre was limited to an island where the circumscribed area made property expensive and consequently high houses were the rule at Tyre, as in Constantinople and Rome. Houses of ten stories were mentioned by several Greek historians as being numerous in Tyre and other seaside cities of the East. We know that the tenement houses of Jerusalem must have been very high buildings, as eight and ten stories are mentioned, and one rabbi speaks of having to climb over 100 feet in the air before he could reach his room. Athens had a building law limiting the height of structures for residence purposes to ten stories, though the height of these stories is not mentioned.

The walled cities of the Middle Ages rendered land valuable for building and, consequently, to secure proper returns, capitalists were forced to

erect high structures. On the other hand, therefore, the legal authorities were obliged to enact building laws to prevent these buildings being so lofty as to endanger the public safety. The islands on which Venice was built were limited in area, and property was valuable, so much so, in fact, that the Council was compelled to pass a building law limiting the height of buildings to 70 feet. In Florence, so long as the city was confined by walls, the limit was 100 feet; in Paris, 60 feet; in Toledo, 75 feet. Rheims had a curious building law forbidding any structure for residence purposes to be erected higher than the eaves of the cathedral, and it is recorded that whenever a building was going up the sexton was enjoined to look out daily from the portholes in the eaves and see that the walls of no structure rose higher than the level of his eyes. The burghers of Amsterdam probably borrowed the idea from the Council of Rheims, and ordered that no tenement or residence house should be higher than the third story of the Rathhaus, this building being the pride of the city, being thus jealously guarded in its preeminence over all others.

The building laws of both ancient, mediæval, and modern times have not generally applied to structures other than residence and office property, and it is marvellous to what an extent the architects of ancient and mediæval days succeeded in rearing strong, stable and lofty buildings. The Birs Nimroud, or Tower of Babel, now only a mound, has been partially excavated, and from the portions that have been uncovered it is estimated that this tower or temple must have had sixty stories and been from 500 feet to 800 feet in height. The Pyramids of Egypt, among the earliest human monuments, are also the most stupendous. The Mexican pyramids, erected at an unknown period, rival, in size and dimensions, the second class pyramids of Egypt.

In comfort and convenience no dwellings of any age can compare with those of our own day, but so far as solidity of construction is concerned the ancients built as substantially as the moderns, and in even the great tenement buildings of Rome, Constantinople, Tyre and Jerusalem the quality of the materials employed and the close inspection of government officials rendered these structures so substantial that the falling of a house from any cause, save by fire, was a comparatively rare occurrence.



FRANCE'S NEW SANITARY LAW AS APPLIED TO CONTRACTORS AND BUILDERS.

IT is quite time that the Prefect of the Seine took up the important question of applying necessary hygienic precautions in the case of the demolition of structures to make way for city improvements, writes E. Conner in "The Quarry and Builders' Merchant" of London. Sanitation is still weak with the French. To effect the above a commission has just been appointed, having for duty to study the subject in all its details; it comprises the head architect of the Prefecture of Police, the latter gentleman being assisted by two well-known physicians. A series of prescriptions have accordingly been drawn up, imposing upon all contractors for works of demolition the necessity of cleaning, watering, and sweeping of all cellars, underground stories, ground floors, and different flats, and not to neglect to incinerate on the spot all debris or rubbish and detritus of every description, especially old papers and rags, before even attempting to begin demolishing operations, the better to avoid infection. This decree is quite new, and will likely astonish many people:: but of late years sanitary measures have been so little attended to in Paris, that it has become necessary and indispensable for the authorities to have recourse to severer laws in order to grapple more effectively with centers of contagion. Paris, they maintain, is the "City of Light"; it must also be made a hygienic metropolis as well. Were vacated premises about to be delivered to the pick axe, and spade, to be oftener periodically visited, as they should be, there would be almost no necessity for raising any question respecting their sanitary conditions. What would be more disgusting than accumulated filth? A museum of detritus, composed of remnants of all that is useless in social life, such as old upholstery, offensive kitchen stuff, ought to be done away with as soon as possible, for health sake, to say nothing of walls sweating since years with abominable dirt, and a collection of household ordures collected together since weeks, and allowed to poison the atmosphere by slow decomposition. The municipality is the proper body to see that the thorough disinfection of all suspected premises be carried out satisfactorily. Five years, and even less time, suffice for premises to become contaminated by inmates suffering from contagious maladies. Though families were compelled, by the law of November 30, 1892, to inform the sanitary or police authorities of any cases of infectious disease, they fail too often to comply with that decree. Now, since the new law has been voted, there is no excuse possible, nor will any be in future tolerated. All quarters previously occupied by either dispensaries, private hospitals, or even midwives, will be rigorously dealt with according to hygienic principles. All cesspools, whether of a fixed or movable nature, all wells, all cellars employed as stores for cheese and organic matters, private sewers, subterranean piping, walls, etc., are henceforth to be sprinkled over with a solution of 3 per cent. of sulphate of iron, then proper-

ly whitewashed with a solution of quicklime. The greatest care is also to be taken to make sure that the lime wash employed is made with genuine quicklime, and not adulterated with carbonate of lime or whitening. Alum though may be added, the better to enable the lime to unite with the water. In any case, this lime wash of late is becoming less adopted. It was accepted as an efficacious substance against epidemics and infectious disease. It action upon microbes has been fully recognized; besides, this wash possesses the advantage of absorbing both dust and germs rapidly, while being easily converted into carbonate of lime. However, the authorities maintain that any wash prepared from whitening is to be strictly avoided, due to it containing a gelatine, which is considered more or less putrified, and so constitutes a fertile breeding ground for bacilli.

As a general remark, the demolisher or contractor delivers up the soil or site of the knocked-down premises only on a level with the street or public highway by filling up the cellars, cesspools, etc., with the rubbish. Consequently, the basement is but seldom dug up. Most foundations of structures in Paris are left unmolested by demolishers; the only time when contractors do so is when they think they can derive anything therefrom, such as good building stones, lead, piping, etc., that can be used with profit elsewhere, or that would at all pay for extra labor. It is only later, perhaps a month or so after, when the navvies come to open the trenches for the sewers, or to lay the necessary foundations for the new building, that a series of infected cesspools, sewers, etc., are discovered. Builders are not the less compelled by law to dust all these many centers of disease with a preparation composed of one pound of pulverized sulphate of iron, and two and a half pounds of quicklime; while all debris emanating from the demolition, and other excavated material, must be transported to the specially indicated discharging stations or points situated outside Paris. By way of further precaution, builders are also obliged to erect boarding of a certain height, so as to prevent the dust arising from the excavation from penetrating into neighboring premises. The law also prescribes certain conditions which are to be kept in view at all times as regards the actual demolition process; in fact, all contractors must bind themselves to observe them faithfully before being even permitted to commence operations. They are the special sanitary inspectors and physicians of the commission, who are bound to see that all these measures of precautions to avert epidemics are carried out in accordance with the law, previous to the works being commenced. They are also expected to take note of all infected houses; but it is upon the service of architecture that devolves the execution of the said measures.

The construction of sewers and the making of streets exact a great deal of attention to hygienic rules. The nature of the soil of the site, if marshy, for instance, will require vigilant investigation, for the simple reason that the majority of such soils are nothing better than so many sources or beds of typhoid and intermittent fevers. This fact was fully exemplified recently in the construction of many of the new streets in Paris, notably the Clignancourt district, whose transported soil was employed in the leveling up of the Champ-de-Mars. In 1871, when the new theatres of the Porte Saint Martin, and Madame Sarah Bernhardt's late playhouse, La Renaissance, were being

built, it was necessary to sink the foundations in the moats of the ancient boulevards of the city. Now, in the carrying out of these operations, the air, as well as the disturbed infected soil, always give rise to fresh outbreaks of typhoid and intermittent fevers. But every day brings forth new illustrations of these facts. At Reims, in Belgium, at Havre, and at Nantes, the proofs were only too evident of an epidemic succeeding careless attention to the nature of the soil, as well as to the buildings constructed thereupon.

Demolitions, along with the disturbing of old soil, provoked an epidemic of typhoid fever at Bourg, in 1894, among an infantry regiment. In no way could the water be held responsible for the outbreak of the disease. Sanitary authorities, therefore, came to the natural conclusion that such maladies as diphtheria, pneumonia, and grippe were to be traced and attributed to the micro-organisms being set free by the excavating processes of the adjoining soil. Many other similar cases are to be recorded: to-wit, when cleaning the large canals in the park of Versailles, and also in the case of the lake at Enghien. The mud and detritus extracted from the two latter were placed in strata or layers, eight inches thick, and sprinkled over with 100 grammes of sulphate of iron, and 200 grammes of quicklime. The consequence of adopting such sanitary precautions was, that no epidemic of any kind occurred, while the lakes themselves were thoroughly cleaned out in addition. These importantant facts are not to be lost sight of at the present moment—when the excavations for the 1900 Exhibition are so many and so extensive. There are structures to be erected on both sides of the River Seine, from the Pont-de-la-Concorde to the Champ-de-Mars, to accommodate a general stirring up of the soil in the vicinity. Now, as the city of Paris has been built in a marsh, paludinous fevers are to be expected, while the Seine occasionally overflows its banks and floods the low level soil. On the banks also have been deposited since years most of the street cleanings and sweepings-up of the capital. These filthy accumulated collections of once city rubbish have to-day become a solid mass, and acquired a rock firmness, by allowing them to remain so. No immediate danger need be apprehended; but there is very serious danger in opening up this hard bed of disease, more especially as they surround the Exhibition site; the absolute necessity of complete disinfection of such openings is all the more apparent. The sanitary authorities have consequenty taken up the matter, and recommended sulphate of iron and quicklime combined, either in the form of a powder or merely as a solution, for sprinkling and whitewashing purposes.

PRACTICAL STONECUTTING—XVII.

EXPLANATION of the "Tangent System Method" by means of which the bed, joint and face moulds may be developed, together with directions showing their application in practice at the banker, as required in order to bring to the desired shape, the lower piece of coping, the plan, etc., of which is shown in Fig. 1 of Plate 15.

The simple problem presented in this plate is similar to that shown in the diagrams of Plate 7, in which the construction of a cardboard model, together with a full explanation of the method by means of which the moulds as required in order to form the stone, is given. As we shall have frequent occasion to refer to the diagrams in question, we shall assume the student to have mastered the problems there explained before he attempts to work out the one here given. If this has been done he will find no difficulty in working out the diagrams now to be explained.

In Fig. 1 is given the plan which is a fac-similie of that given in J-M-U-R of Fig. 1, Plate 1. The rise of the coping as there given in E-Z, equals 9 inches, that is, the lower piece of coping in going around its curved plan rises the height as given. This is set off at C-D, and M-6 of Fig. 1 of this plate; then joining B-D, the inclination of the coping over the Tangent B-C, is given. In a similar manner joining A-6 and the "full inclination" of the coping may be projected.

This understood, proceed by drawing S-7 parallel with A-6; then produce the "level tangent" B-A, as shown to A, and in the manner shown in the diagram project the right section 8-8-H-10 of the coping. Then parallel with S-7 through the corner H draws S′-L. Then square with S′-L draw S′-S and I-X; this gives in S′-S the height required of the rough stone out of which the coping may be formed. With a scale of equal parts this will be found to equal 1-3¼. Now produce the plan ordinates to meet the line S′-L, and in the manner directed for the like operation in Figs. 1-5, plate 7, proceed to project the bed and joint moulds shown in Fig. 2; the face moulds of Fig. 3; and the bevel No. 1, of Fig. 2. The bevel No. 2, of the upper joint may be found as follows: From the point 3′ at which the joint line U-3′ meets the concave curve of the bed mould, parallel with the ordinates as L-L, etc., draw 3′-3″, then parallel with the level tangent B-A, produced draw 3″-N, and at right angles with the tangent draw M-N. Now at the upper joint line of Fig. 1 set off D-N equal with 3″-N of Fig. 2; then parallel with the tangent B-C draw N.O. Then at the upper joint surface of Fig. 2, set off 3′-O, equal with D-O of Fig. 1; then with the half width as A-H, Fig. 1 of the coping, as the radius, and C, of Fig. 2, as the center, draw an arc in O; then drawing C,-W through O, gives the position of a level line at the joint surface, and C,-E drawn at right angles with C,-W gives a "plumb line" at the surface. Understanding this, square with the upper joint line U-3′ draw X-D-X, equal to V-A-W of the lower joint surface. Then parallel with U-3′ draw 3,-D-3,, and U-X-9. The point D in which the center line of the joint surface meets the plumb line C,-E gives the center point of the right sec-

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PLATE 16.

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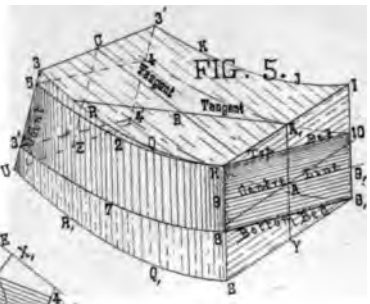
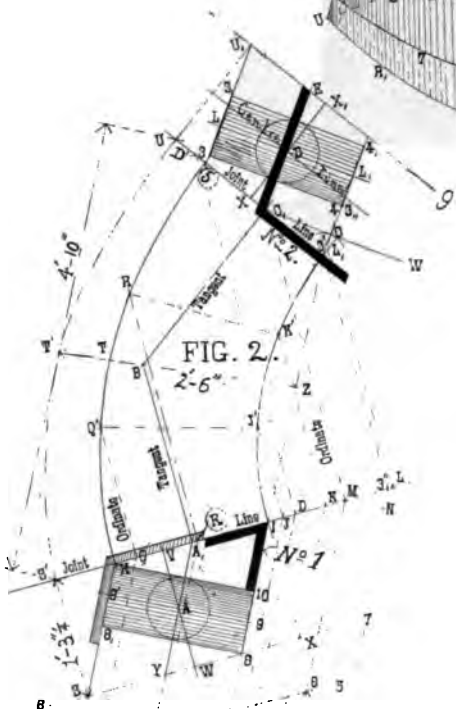
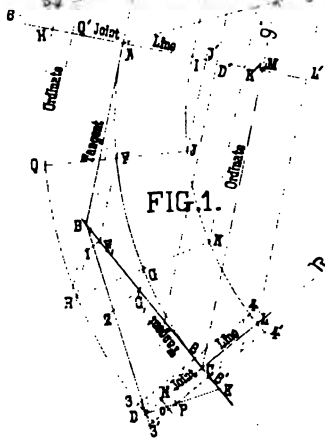
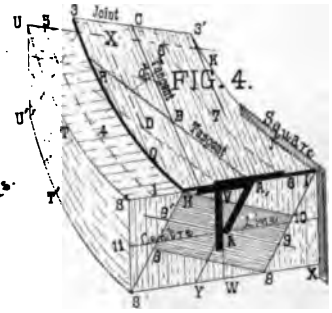
ASTOR, LENOX AND TILDEN FOUNDATIONS









tion. Now in the manner shown in the diagram (fully explained in the construction of the cardboard models) project the curves of the section.

Then from the point given in U, square with the joint line draw U,-U; then taking T′-T as a mean of H-S′ and U-5, a curve traced through S′-T′-U gives the contour of the rough stone at the convex face. Then joining I-3′ of the concave face and the required size of the rough stone may be ascertained; that is, the length of the stone is given in S′-U, the width in T′-Z, and the height in S′-S; with a scale of equal parts these are found to equal respectively 4′-10″, 2′-6″, and 1′-3″¼. Cube contents of stone equals 15′-4″.

Now to cut the stone: Having selected a stone of the size required, bring the top to a plane surface, if the stone be cut by "hand" tooth chisel it, if by machinery leave it from the "saw." On the surface mark the joint lines as given by the bed mould, and transfer correctly to the surface in question, the "Tangents" A-B-C, of the mould; these are represented in Fig. 4 by the lines V-D-X. Now cut the joint surfaces "square" with the working surface. The square may be made use of to give the direction for forming these surfaces. In using it apply the blade in a direction "parallel" with the tangent marked at the working surface.

Having cut the joint surfaces, at the points given in V-X of the tangents Fig. 4, apply the square and as shown in the diagram mark at the surface of the joints, lines at V-A-W at right angles with the working surface. Then set off V-A equal to the half thickness of the stone, and through A draw Y-A-A, to the direction given by Bevel No. 1, applying it as shown in the diagram. The same operation may be repeated at the upper joint surface, making use of Bevel No. 2, to give the direction of the plumb line required. Now through the points given in A,-C, by the bevels parallel with the tangent lines V-D-X draw A,-B-C, that is, draw A,-B parallel with V-D, and B-C parallel with D-X. The bed mould has now to be again applied to the working surface in such a manner that its tangents are exactly over the lines A-B-C, just marked at the surface of the stone when the lower joint line H-I may be placed to the lower joint surface; what is meant may be clearly seen on referring to the diagram Fig. 4. It may be noted the mould projects over the upper joint surface; in marking the bed mould upon the lower surface the reverse condition will obtain, that is, the mould will not reach to the upper joint surface. This point has been fully explained in preceding plates to which we may refer our readers. Now having marked upon the upper and lower working surfaces of the stone the curves as H-Q-R-3, etc., of the mould, proceed to form the cylindrical surfaces in the manner an ordinary piece of circular ashlar may be worked. Now mark upon the joint surfaces the joint moulds projected as at Fig. 2, noticing that the points already given in A-D are respectively the center points of the sections. We now obtain in H-5-3′-8, etc., Fig. 5, the points at which to apply the face moulds, of which Fig. 3 shows that required to give the direction for forming the top and under the concave face are given in 10-4-4′-8, of Fig. 5. The top and under twisted surfaces may now be formed in the manner directed for the similar operation in Plate 12.

C. H. FOX.

AMERICAN AND ENGLISH MACHINERY AND TOOLS.

MR. WALTER DIXON, a member of the Institute of Electrical Engineers of Great Britain, recently visited some of the great workshops of this country with the particular object of seeing the extent to which electricity and electrical appliances are used in our industries. Upon his return home Mr. Dixon told of the things that impressed him, in a paper which he recently read before the West of Scotland Iron and Steel Institute.

The direct reason of his visit, he said, was to find out the truth regarding the remarkable tales which he read in our technical newspapers of the use of electrical machinery and appliances in our shops.

"I have for some time had very great difficulty in deciding to my own satisfaction what to believe and what not to believe," he says, "of reported American practice. Many of the descriptive articles which one was most inclined to relegate to the side of fancy were illustrated by what appeared to be photographs of actual machines and actual applications, so that, while it was difficult to believe in the fiction theory, it was at the same time a little past one's comprehension to believe anything else."

Mr. Dixon found, to his astonishment, that all of these almost incredible tales were true. "When I state," he says, "that there is probably as much electrical machinery employed in some of the single works in America as there is in the whole of the steel and iron works of our own country combined, you will at once agree with me that their practice is sufficiently wide and divergent from ours to warrant some consideration."

The first thing that struck Mr. Dixon as remarkable about our works was the control exercised by young men, and next the efficiency of our workmen.

"I have been intimately connected with large numbers of our workmen for the past twenty years or more," he said, "and I talked labor questions over with many classes in America and have come to the conclusion that, just as our men, generally speaking, are bent on doing as little as possible in a given time, the American workman is bent on doing as much as possible."

In going over the American iron and steel works, he says, one cannot fail to be impressed by the scarcity of operatives, due to the use of labor-saving machines, and that he often refrained from taking photographs of works in full swing because the fewness of men at work gave the places a closed-down appearance.

"The fewness of workmen is not, however," he says, "more strange than the activity of those who are employed. The British labor, both skilled and unskilled, appears either by design or accident to have worked itself into the condition that each trade individually vies with each other, and the whole

combined trades vie together in discovering the greatest amount that can be extracted in wages out of each and every piece of work."

With young men at the helm, the Americans, he discovered, were always ready and willing to try new ideas, and though their failures were many their successes were also large in proportion.

"So far as I could judge," Mr. Dixon says, "the American appears perfectly fearless of foreign competition, and is a stanch believer in the survival of the fittest; and, what is more that the weak will go to the wall. He knows that if he is weak he will go to the wall, and is hence always on the move to do something clever. You can see it in the iron and steel business and everywhere. It is this which makes them what we should call 'foolhardy' with one another, and, if one may so put it, with ourselves; they do not care who sees what they are doing. Their works are equally open to the stranger and to the competitor. It seems an inbred idea with them that if they cannot themselves keep up to date, be at least as good if not better than their neighbors, they are bound not to succeed.

"I spoke of strikes to them, and they replied by referring to the various handles, the movement of which, by unskilled hands, made their steel.

"The progress of the American iron and steel industry has advanced by leaps and bounds, and at a rate which is almost incomprehensible. How unexpectedly can, perhaps, be best understood by reading what was written twenty to twenty-five years ago in the transactions of our own parent and other societies. I have not seen that anybody, even in their wildest moods, ventured to predict twenty years ago that before the end of this century the Americans, instead of importing, would be exporting iron into our own country and be serious rivals in all our foreign markets, and we have not yet, as a nation, accustomed ourselves to the idea that our neighbors across the water, who are brethren with us in civilization, energy and ability, have at their very doors, in inexhaustible quantities, all the resources which have been instrumental in putting ourselves into the position we have attained. That the Americans will continue to harass our foreign trade nobody doubts. Whether they will continue to compete with our own manufacturers here in good and bad times remains to be seen, though in the minds of the Americans themselves, and those of our nation who best know America, there is little doubt."

AN ENGLISH OPINION OF AMERICAN MACHINE TOOLS.

At a meeting of the English Society of Engineers, held at the Royal United Service Institution, Whitehall, London, on April 10, a paper was read on "Machine Tools" by Mr. Ewart C. Amos, M. I. Mech. E. In his opening remarks, says the "Colliery Guardian," the author pointed out the importance of engineers being well acquainted with the most modern practice in regard to the construction of machine tools. He further added that, owing to the important part now played by machinery in the world, the progress of this country in relation to others would be largely determined

by its capacity to turn out the best and most improved tools. The author then referred to the distinctive features of modern tools, directing particular attention to the fact that it had now become the practice to substitute for one machine doing a great variety of work a number of machines, each dealing with one class of article. Modern practice also called for greater accuracy and more automatic machinery. He observed that ball thrust, hollow spindles, cut toothed gear, and other refinements had now become very general, and resulted in the production of better work at less cost. He then divided his subject into a series of headings, which included, amongst others, lathes, drilling, boring, milling, planing, shaping, slotting, keyway-cutting, punching and shearing, plate-bending, metal-sawing and forging, and welding machines.

Under the lathe section, descriptions were given of some powerful machines by Sir William Armstrong, Whitworth & Co., Limited, including a 20-foot faceplate brake lathe weighing 178 tons, also a special lathe for boring out and chambering guns. The author also devoted considerable space to a description of various forms of capstan lathes with wire feeds and chasing apparatus, pointing out what an important tool this had become. Of drilling machines several useful types were described and illustrated, including a semi-radial drill of American design, which is of entirely novel construction. The author's reference to milling machines indicated the importance he attaches to this class of tool, which is now in so much demand in all well-appointed shops, and is made in such a variety of shapes. A number of other tools under the headings enumerated were also described, and in most cases illustrated. The author then described several hydraulic-power machines, and under another heading gave a description of another class of tool now coming to the front—viz., the pneumatic. Some useful information was given as to their advantages and economy. Some figures and data given in this connection showed that in drilling four times as much could be done as compared with hand drilling, and that they effected a saving of some £50 to £75 per annum per tool, even in a comparatively small drill. A working size pneumatic hammer was exhibited.

The last two divisions—viz., British v. American tools and good v. cheap tools—were as interesting as any, and afforded considerable scope for the discussion which followed the reading of the paper. Under the British v. American heading the author closely compared the two makes, and whilst he said he felt bound to give considerable credit to American manufacturers for their ingenious and well-thought-out designs and well-finished machines, he also considered that the home products would probably excel them if our manufacturers could see their way to discard some of their old patterns. The author concluded this section by pointing out that although our markets were already encroached upon by the American makers, yet the prospect of a largely increased demand for machinery in the near future would tend to provide business for makers of both countries, securing at the same time a healthy competition. Under the heading of cheap v. good tools the author

expressed himself very strongly in favor of good tools, and showed that they were in the long run cheaper than the so-called cheap tools, although higher in the first cost.

AMERICAN TOOL-MAKING IN GERMANY.

"The Trades Journal Review," published in London, prints the following article with the little tag at the end to keep up the courage of English manufacturers, against the inroads of American competition:

German tool-makers will soon have one of their most powerful American rivals at work in the Fatherland. Col. Alexander Gordon, the founder and president of the Niles Tool Works Company, U. S., has returned to America after a prolonged stay in Europe for the purpose of establishing the new machine tool factory, reference to which we have already made in a previous number of this Journal. Some tall talk is being indulged in as to the extent and equipment of this new factory, which, it is said, will cost £400,000. Final details of the shop plans are now being worked out by a German architectural firm. The machine tools will, of course, be mostly of the Niles Company's manufacture, although it will be necessary to purchase certain tools which are not among their own specialties. The large machines will have independent electric motors, the smaller tools being driven from shafts which will each have their own separate motors at end of shaft. Some of the largest tool users and buyers in Germany, such as Messrs. Borsig, of the locomotive works, Berlin; Stahl, of the Vulcan Company, Stettin; and others, are either on the board of directors, or otherwise connected with this new concern. Col. Gordon is reported to have expressed great confidence in the possibilities of the Russian market, and expects that the construction of the Trans-Siberian Railway will open up a tremendous field for machinery. We sincerely hope the Colonel will not be disappointed. We all hope for large developments and openings for new business to follow the completion of the great Russian Railway; and it will be strange if British toolmakers do not manage to secure a large share of the work, particularly in the supply of the heavier tools, in which they are sure to maintain their pre-eminence. This great American factory will have some difficulties to contend with in Germany which perhaps the proprietors have not fully reckoned upon; and although they may introduce and cheapen the smaller classes of tools in Europe, the Americans have still a long way to travel ere they can produce work that will bear comparison with the heavier descriptions of machinery made in this country.

NOTES ON THE DRIVING OF THE SIMPLON TUNNEL, SWISS ALPS.

IN taking up as subject the driving of this tunnel, I do not intend to expound beyond measure the facts appertaining to it. I simply wish to give a general insight of the work, having had the opportunity of examining it and being acquainted personally with the engineers in charge of this gigantic work.

The object of the Simplon tunnel is to extend the line "Jura Simplon" by going through the Simplon Mountain and permitting the junction of this road with the Italian System.

The tunnel will be approximately 23,000 meters long. It starts at Brigue on the Swiss side, and has its outlet in Italy at Isellen.

The project designed, and now in course of being carried out, work having started two months ago or so, provides for the construction of two parallel tunnels which shall be joined by cross cuts driven every 100 meters. The object of this second tunnel is to improve and facilitate the ventilation of the tunnels during the course of the work as well as after the completion.

The firm, Brandt & Brandan, of Hamburg, which is well known for having driven different tunnels, such as "Arlberg," "Caucasus" and part of the "St. Gothard," has taken the contract en bloc for the work. In five and a half years the two tunnels must be completed, masonry work finished and tracks laid down. For each day of delay after this the contractor shall have to pay a fine of 5,000 francs ($1,000). On the other hand, for each day gained on the agreed time he shall receive a bonus of 5,000 francs. The contractor feels satisfied that he can gain half a year, and I must say that the measures taken by them seem to fully justify these hopes.

It is rather difficult to realize what preparations have been necessitated by such an enterprise. Thorough soundings, by borings, have been made of the whole mountain, which have revealed to the contractor the exact section and what rocks he has to deal with, and to provide himself with the necessary apparatus.

Yet the problem to be solved is very complicated, and can be classified as follows: We shall review it rapidly under the following headings:

1. Surface installations.
2. Mode of work for the driving and power used.
3. Ventilation.
4. Refrigerating plant.

Surface.—A small town has sprung up at each end of the tunnel. To describe one is to describe both, for the tunnel has been started from both sides, on the Swiss side side at Brigue, and on the Italian side at Isellen.

Besides dwelling houses for the workmen, a dynamite factory has been built, on account of the great quantity of explosives necessitated by such a colossal enterprise.

The principle of all the power employed is the use of water under high pressures. Where natural falls can be utilized under the natural head of water, it is used as such. But for the drills working by hydraulic pressure a

*Read before the Canadian Mining Institute.

series of compressors have been put up which give pressures at the drills of 50 to 150 atmospheres. This corresponds to 2,700 lbs. per square inch.

It is remarkable to notice with what ease such huge forces are transmitted without leakage at the joints or bursting of pipes.

Mr. A. Brandt, the head of the firm, works with machines of his own designs, which are made by Seilzer Brothers, of Winterthur, who are very skilful and conscientious constructors.

I would strongly advise all persons interested in such works, and who have a chance to do so, to pay a visit at the work shops of this firm, which owe their origin to private enterprise, in a country without coal or iron and having as only advantage on the other constructing firms of the world, the qualities of industry and heartiness to work which are the distinguishing features of the Swiss people. In a small town, without apparent prospects, the Seilzer Brothers have given rise to an industry which employs more than 3,000 men, men to whom they are insuring a life prosperous and happy.

The compressors used by Mr. Brandt are made very carefully. The principle is quite simple. The engines are double or coupled; on each side are two steam cylinders, one high pressure and one low pressure. On the same axis on each side is a differential or force pump which forces water directly to where the force is used, with an intermediate so-called accumulator, which is only a safety valve, which is laden with weights to obtain the required pressure. If the rock is very hard additional weights are put on the accumulator of which the reaction or throbs are checked by strong steel springs.

This enormous pressure is obtained without noise and the power is taken to the workings without the observer being able to detect the least abnormal noise.

I think that the success of these apparatus is mainly due to the excellence and perfection of construction.

Therefore, in the surface plant of machinery, the power is generated according to those principles. High pressure everywhere, even the boilers. The boilers are small and yield enormous quantities of steam at very high pressure, which is a principle eminently economical and practical. None of those huge boilers with low and costly pressure. This principle of high pressure is apparent everywhere and seems to influence the workmen, who also appear to work under high pressure.

The power is received at the different working places to work the ventilating fans and drills. We are going to consider these and say a word about the working of them and show the efficiency obtained from them.

Work Carried on in the Tunnel.—The rock is attached by rotating drills worked by hydraulic pressure. A light frame on a carriage carries to the breast work a horizontal column with a piston, on which two drills are attached. The whole is arranged so as to take up as little room as possible. It is like a closed umbrella which is opened when the carriage has reached the working place.

Then the column is put in place and wedged in. A tunnel of small dimension is always first driven. This is subsequently widened to the size of the finished section.

When the column is set in place, water under pressure is introduced through a small flexible copper pipe of less than a fifth of an inch. This acts on a large piston which wedges the column in an immovable position.

The drills proper, which can be moved on their axes in all directions, are then fixed on and the bit attached; the drill is then put under the pressure as explained before.

The bit is made of hollow tube through the interior of which passes the waste water. In this way it is used to clean the hole. The bit is made of exceptionally hard steel and has three teeth which tear the rock. When the holes are completed the machine is taken away and the blasting is made. Here, a point which may be of use to the miner may be noticed. The quantity of dynamite used is so large that the rock is not only torn asunder, but powdered and almost burnt.

No savings are made of explosives. This is an essential point when time is the real factor.

The mode of working of the drills is very ingenious. The apparatus as a whole is simple. The movement of rotation of the tool is obtained by two small hydraulic motors of which the dead centres are cranked at 90 deg. The forward motion is given by the water under high pressure, acting directly on a large piston, placed below the bit. The backing motion is obtained by turning a valve. The workman in charge of the machine has complete control of it and can easily take off two of them. I had the opportunity to work one of these machines myself and succeeded in obtaining in an ordinary granite, an advance of 21 feet a day in a drift of a section of 7x7 feet.

The changing of the bit is very rapidly made, and the lengths are graded to obtain the maximum advance.

If the sum spent in getting out of the "debris" could be saved, an economy of time of 50 per cent. could be effected.

Here Mr. Brandt proved himself equal to the occasion. He has not suppressed the carting away of the clearings, but he has succeeded to effect it simultaneously with drilling and blasting. On one side of the tunnel he has placed a large pipe with water at high pressure. This pipe is about ten inches in diameter. At the end, near the breastwork is a fixed elbow with a flattened conical nozzle, directed in the axis of the rails. Immediately after the shafts have been fixed the whole of this apparatus is covered by the debris, the quantity of which, however, is a minimum on account of the large quantity of dynamite used. The valve is now opened, and the enormous volume of water under pressure sweeps the fallen rock out of the way, clearing the rails and breastwork sufficiently to allow the drills to advance and resume work. The clearing goes on therefore below the drills and to their right and left while they go on with their work.

While this small opening tunnel is being driven forward, other apparatus are at work behind widening the section to the required size.

But the organization of the work is such that everything is effected systematically without disorder. Each section works without interfering with the other. One goes on unimpuled over the other, and the masonry work advances without interruption night and day.

It is interesting to see entering the tunnel simultaneously, the material for the timbering of the temporary drift, the bricks and cement for the masonry of the finished section and at the same time the debris of the blasting are carted out. And these do not in the least interfere with one another. The work follows its normal and regular course; such is a beehive where every individual has his work cut out and knows exactly what is to be achieved.

Ventilation.—It is easy to conceive that ventilation in such a work is of first necessity and importance. In spite of the two tunnels, an energetic artificial ventilation has to be resorted to.

Mr. Brandt has solved the problem as follows:

He uses high speed fans, not less than 3,000 turns a minute. The air forced by this fan is received by a second and forced to a third and so on. By this means, with a series of apparatus comparatively small and unobstructive, he has succeeded to provide enormous quantities of air at suitable pressure This is another of those simple ideas which give the best results.

Refrigeration of the Workings.—This is another point which is a source of worry to the contractors. It is the heat which is met with at distances of 10,000 feet underground. A temperature of 130 deg. Fahr. is expected. Then the question comes up, how is the work to go on in such temperature.

The driving of the St. Gothard tunnel has demonstrated that beyond a certain temperature few temperaments can resist and the sick lists attain alarming proportions.

It is intended to solve the problem as follows: After each shot, a shower of ice cold water derived from the glaciers, shall be sprinkled on the breastwork. As water absorbs a large amount of heat the temperature after this operation shall be considerably lowered.

Also, the air from the fans will be made to pass through coolers and over material absorbing moisture. For, it is not sufficient to send cold air where ventilation is needed, but this air must also be dry. Experience has shown that excessive moisture has a depressing effect on the men.

LEOPOLD MEYER, M. E., Ottawa.

THE PRODUCTION OF STONE IN 1898.

THE report on the production of stone in the United States in 1898, by Dr. William C. Day, of the United States Geological Survey, has just been completed. The entire total valuation, $38,270,354, shows an increase of over two million dollars for all kinds of stone produced in 1898 over that of 1897, which was $36,070,651. As shown in the following table, there was an increase in the value of every kind of *stone except marble*, which fell slightly below the production of 1897.

VALUE OF DIFFERENT KINDS OF STONE PRODUCED IN THE UNITED STATES IN 1897 AND 1898.

Kind of Stone.	1897.	1898.
Granite	$8,905,075	(a) $9,258,406
Marble	3,870,584	3,629,940
Slate	3,524,614	3,723,540
Sandstone	4,065,445	4,619,412
Limestone	14,804,933	16,039,056
Bluestone	(b) 900,000	(b) 1,000,000
Total	$36,070,651	$38,270,354

(a)—Includes trap rock valued at $927,961.
(b)—Estimated.

In the reports giving the value of the different varieties of stone in the individual States, a gratifying outlook for the stone industry in 1899 is shown. For 1898 Pennsylvania takes first place in the value of entire product, followed by Vermont, Ohio and New York in order named.

A table showing the value of the trap rock by States has been introduced for the first time this year. Trap rock production, valued at $927,961, in 1898, has become a very important feature in the granite production of New Jersey, New York and Pennsylvania, and largely accounts for the increase in the granite figures.

The chief feature of the slate industry is the steady increase of the export trade. In 1897 the value of the slate exported from the United States, as furnished by the Bureau of Statistics of the Treasury Department, was $780,112, while in 1898 the value was $1,370,075. The average price per square for roofing slate in the United States in 1898 was $3.42, while in 1897 the value was $3.09.

The limestone production shows an increase in the value of lime made, and those interested in any way in the stone product of the United States.

The chief feature of the report, however, is the collection and tabulation of a large number of analyses and tests of stone from the principal stone localities in the United States. The reports of these tests and analyses were in most cases obtained directly from the stone producers, the object being to publish in convenient form for study and comparison such information relating to the various kinds of stone, as would be of value to the quarrymen and those interested in any way in the stone product of the United States.

Comment on Timely Topics

ENGLISH VIEWS OF OUR MACHINERY AND TOOLS.

THERE is needed no apology for the publication in a magazine devoted to the stone industry of the three articles in this number grouped under the heading "American and English Machinery and Tools." The close relations that exist between the steel and the stone and building industries, would make such articles always timely and interesting to the readers of this magazine. They have an especial appropriateness, however, because a large part of the growth of our export trade, upon which our present financial prosperity is largely based, is due to the market that our tools and machinery have found in other countries. No subject is more talked about in technical journals at this time than the growing appreciation of our products in this line in the markets of the world. Nor are English and foreign papers one whit behind us in the keenness with which they discuss the subject, although their points of view are so diametrically opposed to ours.

The most suggestive of the articles is an abstract from the paper read by Mr. Walter Dixon, before the West of Scotland Iron and Steel Institute. To an American it seems strange that any one should express surprise because we are ready and willing to try new ideas and are fearless of honest competition. These very qualities are ingrained in our nature, and it is upon them that our great industrial system has been built. We doubtless have inherited a certain portion of English conservatism, but it does not manifest itself in clinging to antique ideas. Mr. Dixon is very frank and fair, and he shows the cordiality and good will which have recently marked English judgment of things American.

Mr. Ewart C. Amos, who read a paper on "Machine Tools," before the English Society of Engineers, has not succeeded so well in clearing his mind from prejudice, although there is no touch of bitterness in what he says. He does not refuse to give credit to American engineers for their "ingenious and well thought out designs and well finished machines," but he is sure that "home manufactures would excell them if they could discard some of their old patterns." There is large virtue in this "if." For years past England has been given every opportunity to discard old patterns and the hints in that direction have almost developed into kicks. In the face of demands from the colonies where England should gain her surest market, her manufacturers have resolutely refused to adopt improved patterns for small hand tools, with the result that Americans have captured much of the trade. The *general attitude* of English manufacturers toward improvements and new

discoveries in the mechanical line is one of doubt and discouragement, and until they experience a radical change in this matter they cannot stem the flood of American exports.

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The article from the "Trade Journal's Review" is like the shouting one to keep up his courage. We have a long way to travel, says the writer, before we can produce work that will bear comparison with the heavier description of machinery made in England. Just what line of machinery is covered by the word "heavy" is not quite apparent. Surely locomotives are not meant, because we can scarcely fill our orders for export, and some of our largest manufacturers of machinery for iron working could report the same state of affairs. There are no better workmen in the world than the English, but they lack the quickness of perception, the adaptability, the readiness of resource, in a word, the imagination of their American competitors.

THE STATE OF THE STONE AND SLATE TRADES.

AS will be seen from reports on other pages of this number, there is unusual activity in all branches of the stone trade. Quarries that have been closed for months, owing to a lack of orders, are now reopening and are running with a full force of men. Others that have been kept busy during the dull times, are increasing their force of operators, and all of them report such a volume of orders as they have not received for several years past. In every way the outlook is most encouraging. In a few of the centers of the quarrying industry, there have been purely local disturbances due to labor difficulties that have, in most instances, been settled to the satisfaction of the operatives and employers. Liberal advances in wages have been granted voluntarily by some of the large employers of labor, and there is every reason to believe that others are merely waiting for more settled conditions to follow this example. It is not to be credited, therefore, that the labor unions will interfere with this onward movement by strikes, unless these should be justified by unbearable abuses.

In the granite, marble, bluestone, limestone and sandstone centers there is general activity, and the same satisfactory condition of affairs is to be noted in the slate regions, which have had a setback for several years past. One correspondent from the Pennsylvania slate field says: "The season which has just begun will be an unprecedented one, judging from the present indications. Orders for export to England, Germany, the West Indies and South America as well as home orders are coming in daily and there is a general scramble among the slate buyers for the limited quantity of slate on hand, while orders are placed to be filled three months later." The New York and Vermont slate operators report equally good prospects. A Granville (N. Y.) correspondent says: "A large number of men are to be employed by the Granville slate manufacturers the coming season. The orders for slate at present are very large." Just now there is a slight lull in the export

trade owing to short supplies. There has been a reduction in the schedule of prices of Welsh and French slates, and this has also had its effect on the export trade. But orders are plentiful and the year's business will undoubtedly be very large. New discoveries of marketable slate have been reported. In Colorado a large tract of good slate is said to exist near Marble and quarries will be opened before long. With general business and trade condition as favorable as they are, at present, money will be spent more lavishly in building than ever before, and this means a good market for all producers of stone and slate.

STREET PAVING AND ROAD IMPROVEMENT.

WITH the general improvement of financial conditions, the leading cities of the country will do much in the way of public improvement. The Federal government, despite the unparalleled expenses of the recent war, has set a good example in the large number of public buildings that it will erect. Besides city, town, and county building that will be undertaken by local enterprise, there is outlined a great deal of work in the way of street paving and road improvement. Some of the work that has already been arranged for in Macadam or Telford roads is as follows, the figures in each instance being for square yards: Amsterdam, N. Y., 20,000; Augusta, Me., 5,000; Bloomington, Ind., 5,000; Columbus, Ga., 11,500; Grand Rapids, Mich., 18,520; Hamilton, O., 9,700; Lafayette, Ind., 4,000; Manistee, Mich. 7,515; Meriden, Conn., 15,000; Newport, Ky., 30,000; Port Huron, Mich., 8,000, and two miles of cement sidewalks; Toledo, O., 6,166; Butte, Mont., 17,000. Besides these, Springfield, Mo., reports that it will construct two miles of improved roads. Nashville, N. C., has some work on hand. Columbia, Pa., will construct Macadam roads and add some sidewalk pavements, the amount not yet determined. Haverhill, Mass., will probably vote for new pavements, and Lafayette, Ind., will construct about five miles of cement sidewalks. Minneapolis, Minn., will construct 16,780 square yards of stone paving on sand foundations at an expense of $31,540. Montgomery, Ala., will lay about three miles of cement sidewalks in small contracts. Nashua, N. H., contemplates stone paving on sand foundation. Scranton, Pa., will lay about 36,000 lineal feet of curbing. Terre Haute, Indiana, will construct four miles of cement sidewalk.

All of this is in addition to a great amount of work that will be done, although it has not been reported in advance. This means great business for quarries and crushed stone dealers, aside from the general stimulus that good roads will bring to every line of business.

The Harper Stone Quarry at Rock Falls, Ill., has been opened for the season with a number of contracts on hand.

Quarries will be opened for furnishing stone for the second lock of the Colbert Shoals (Tenn.) canal.

The officers of the Mankato Lime and Stone Company have been cited to show cause why they should not be adjudged guilty of contempt of court in violating an injunction by moving the implements from a quarry leased by them.

Marble has been discovered in the lands of McGugin & Co., at Olive furnace, Ironton, Ohio, and a quarry will be opened.

Charles H. Moore, of Montpelier, Vt., George C. and William Preston, of Kingston, N. Y., and Hamilton McWhorter and Frank D. Smith, of the county of Oglethorpe, Ga., have incorporated the Southern Westerly Granite Company. Capital, $100,000, with privilege of increasing to $500,000. The company will have its principal offices at Atlanta, and will quarry and dress stone in the counties of Sutton, Clark, Elbert, Oglethorpe and Madison, Georgia.

P. Garvey, formerly foreman of the United States government quarries at Kaukauna, Wis., is dead; aged 84 years.

F. H. Kuehner & Co., of Cincinnati, have opened their West Side quarries at Portsmouth, Ohio, and will employ 150 men.

Jacob J. Shuey has been appointed superintendent of the quarries of the Lemont, Ill., Limestone Co.

The Standard Granite Company at Hall quarry, Bar Harbor, Me., will furnish stone for the new United States mint at Philadelphia.

William Koehnline, Charles Appenzeller and E. J. A. Drennan have opened a stone quarry, near Martin's Ferry, Va., and the firm will be known as the Avondale Stone Company.

William Harper has opened up his stone quarry at Rock Falls, Ill., and commenced the season with many orders.

The large bluestone quarries south of Dunbar, Pa., operated by Sloan & McIlvaine, of Allegheny City, were put in operation the first of the month. The quarries have been idle for nearly two years. About one hundred and fifty men are given employment.

At the Oliver quarry, at Charlestown, Ill., a single blast dislodged a ledge of brown sand stone, 100 feet long, 20 feet high and 15 feet wide. Fourteen holes were drilled at irregular intervals and for the first charge ten pounds of powder were used. This cracked the rock. For the second charge fifty pounds of powder were used, and in the third charge five sticks of dynamite placed at the workmen's disposal 500 yards or 1000 tons of stone.

The Columbian Quarry Company is opening up a quarry on the Drake Farr farm, at Monkton, Vt., having leased the right to quarry marble there for a term of years. The surface marble at this quarry is fine, resembling onyx somewhat in color, and taking the polish nicely.

The rock quarry at Corryton, Tenn., is working full time. A number of carloads of stone are shipped daily.

Col. W. H. Phelps has taken an interest in the Carthage (Mo.) Quarry Company.

The Lemont (Ill.) Limestone Company is operating a fine quarry of excellent stone near the depot at that place.

The Chicago Terminal Transfer Railroad

has been enjoined from laying its tracks across the ten-acre tract of quarry land belonging to the late Thomas O'Connell, at Summit, Ill. The laying of the road, it is claimed, will ruin the property for quarrying purposes.

Frank Hagen has opened for the season his large stone quarries at Sturgeon Bay, Wis. Mr. Hagen expects an unusually busy season.

The Rhode Island Granite Works, at Westerly, R. I., has secured a large contract for red granite, and has started up with fifty new men. More men will be added as needed.

The force of men at the White Rock quarry, at Baraboo, Wis., has been increased.

Two hundred and twenty-five employes in the Kenneth quarries, near Logansport, Ind., operated by the Casparis Company, of Columbus, Ohio, have struck for an increase of wages.

The Tidewater Trap Rock Company, to work quarries in Connecticut, has been incorporated in New Jersey. Capital, $100,000.

The quarry owners at Joliet, Ill., have increased the wages of their operators 25 per cent. This is the largest scale paid here for a number of years, and it will affect between 500 and 600 men. The quarry owners have a large number of orders on hand, on account of the great demand for building stone and there will be steady work all the year.

Fifty granite cutters at the quarry of F. A. McCauliff, Fitchburg, Mass., struck for an increase of wages equal to 1 cent a foot.

The blue rock stone quarries near Ligonier, Pa., which have been owned and operated by Asa P. Childs & Co., have been purchased by Messrs. Booth & Flinn, of Pittsburg.

The Bethesda (Pa.) quarrymen have collected among themselves the sum of $575 in order to found a scholarship at the county schools for boys from that district.

Messrs. Towne & Starkweather have stripped their quarry at East Norwalk, Ohio, and begun operations.

Davis Brothers have begun operations at their quarries at Lannon, Wis., and they report a good outlook for the season's business.

The Nebo Brown Stone Company, of Salt Lake City, Utah, has been incorporated, and will operate quarries at Nebo, Utah, to which place a spur will be built by the Sanpete Valley railroad. The stone in the quarries is brown in color, is firm, tough and cohesive, but so far has been little used for building purposes, owing to the difficulty of access to the quarries.

The firm of Love & Handley are increasing their force of men in their East Sioux Falls, S. D. quarries as fast as possible. They have many contracts on hand and say that there is more work in sight than at any time during the past seven years.

The Columbian Marble Company will shortly begin operations in the variegated marble quarries at Mallett's Bay, Vt., which have not been worked for several years past.

The Cornwall standstone quarries, a mile or two below Cloverport, Ky., have at last been put in operation. A large number of expert stonecutters have been employed and extra hands are being put on daily.

The Cumberland (R. I.) Iron Trap Company have purchased a large tract of land in the Diamond Hill district, and will open quarries for crushed stone for road building. The company will erect large stone crushers at this quarry, and it has already established a crusher at Iron Rock Hill. The company will also build a private railroad to Woonsocket to carry its crushed stone.

Assignee Rowe has sold the Leuthold & Holman granite quarry at Waupaca, Wis. It was bid in by Mr. Leuthold.

The Chippewa Sand & Stone Company has bought 230 acres of land at the little town of Warwick, near Akron, Ohio, and has opened a sandstone quarry there. The company has two white stone quarries, one which produces a sand suitable for the manufacture of glass, and another quarry which produces a building stone of a fine brown color.

Mr. Gus Widwell is running to their full capacity his two quarries at Mankato, Minn. The smaller of the quarries, located in the northern part of the town, employs 125 men, and the lower quarry, known as the Klondike, employs 200 men. An average of fifty carloads of stone are shipped each day.

The Ibcox Granite Quarries Company, of Califon, N. J., has received a contract for the delivery of 5000 tons of crushed stone to be used in the streets of Elizabeth.

Stone Trade Notes

The Kankakee (Ill.) Stone & Lime Company has started its big crusher. Brayton & Kerr's stone crusher at the same place, broke a pinion wheel recently and the works were shut down for a brief time.

William Norris, of Findlay, Ohio, has resumed operations crushing stone at his quarries near the Tangent line depot. The plant has been idle since last November.

Wallula, Wash., is sending a few carloads of basalt rock to Walla Walla, where it will be given a trial as building material.

Leatham & Smith, of Marinette, Wis., are building a stone carrying barge, with a capacity of 200 cords of stone to replace the Harry Johnston, lost in a storm last fall. The new craft will be the largest of its kind on the lake.

Alex. McCleary has been appointed receiver of the Bedford Indiana Stone Company, at the instance of the stockholders.

Chicago is testing a pavement of dressed granite blocks. Fifty feet have been laid in Washington street in front of the City Hall. The pavement differs from the old style, in that it has a smooth surface instead of the rough and "hog back" surface of the granite block.

The firm of Evans & Tarbox, of Findlay, Ohio, have just completed elaborate improvements in their stone crushing and lime plants on Factory street. The storage bin has a capacity of 6000 cubic feet of stone, which may be increased to 7500 if desired. A large derrick with screens and a chain conveyor have been added. The crusher has a capacity of 150 cubic yards a day and the lime kiln a capacity of 2000 bushels per fire.

The Furst-Kerber Cut Stone Company of Bedford, Ind., has been incorporated. Capital, $25,000. Directors: W. L. Kerber, Carl Furst and Henry Furst.

G. W. Walker & Co., of Litonia, Ga., is furnishing curbing, and the Ethridge (Ga.) Granite Company is furnishing Belgian blocks for the streets in Athens.

Plans for a beautiful new stone bridge and arch at the St. Clair crossing in Rockefeller Park, Cleveland, have been drawn. The arch will be about 70 feet in width, 50 feet in height and 50 feet in length. The cost is estimated at between $50,000 and $60,000.

The Nebraska Stone Company, of Omaha, has been incorporated. Capital, $10,000. Incorporators: Charles H. Hansen, Peter Laux and A. F. Hansen.

The East St. Louis Stone Company has been incorporated. Capital, $20,000. Incorporators: W. E. Jonston, John Niemo and Peter R. Reiman.

C. P. Keeler has opened a stoneyard on McMaster street, Oswego, N. Y.

Ten stonecutters from St. Paul, Minn., have gone to Helena, Mont., where they have received a guarantee of one year's work at $5 a day on the new State capitol.

Malone & Young, of Westbourne, Manitoba, are building a large steam barge to be used in transferring stone from their quarry at the Narrows to the headwaters of the White Mud River.

A gang of men quarrying stone near Bridgeport, Conn., unearthed a den of rattlesnakes containing more than 100 rattlers.

The trouble between the contractors and stone cutters on the courthouse of DeKalb county, Ga., has been adjusted.

A. Auerbach, president of the Chicago Stonecutters' Union, is working to bring about an agreement with contractors by which the work now done in stone yards may be divided, some companies doing the sawing and other yards the cutting and dressing. The stonecutters do not want to work in yards with machinery and while they have declared war on the planing machinery they have not done so against saws and rubbing beds. Auerbach believes the work could be divided so that no hardship would come to any of the men, either engineers or stonecutters, and the contractors might divide the business.

The Mantorville, (Minn.) Stone Com-

pany has received a large order for bridge stone, to be shipped to Hanover, Ill.

The Board of Public Works of Louisville, Ky., has agreed to employ union stonecutters, and to use only home material in ordinary construction work.

Unless the Stonecutters' Union gives up its fight and permits the granite which is to be used in Chicago's public building to be furnished in the time specified in the contract, there is talk of changing the plans so as to permit finishing the building with bricks or terra cotta. Gray bricks to match the granite have been submitted by a firm in Columbus, Ohio.

The State Capitol Commission of Montana has chosen stone from the quarry at Columbus, Yellowstone County, Montana, for use in the new State Capitol Building. The quarry has not been opened yet, but the commissioners have investigated as to its size and the quality of the stone. Joseph Soss, the capitol contractor; H. S. Hepner, a Helena lawyer, and B. Hager have incorporated the Montana Sandstone Company. The company will open and develop the quarry referred to above.

The cobblestone pavers and rammers of Baltimore have organized the Stonepavers Union.

The Monon railroad this season will fill up over 6000 feet of trestles, substitute a large number of stone culverts for wooden structures, and ballast fifty miles of the main road with broken stone and gravel.

The Connecticut Brownstone Company, of Portland, Conn., has a number of large orders and is working full time.

T. R. Coghlan has been awarded the contract for cut stone for the new St. Joseph hospital at Mankato, Minn.

The Building Trades Council, of St. Paul, Minn., is working to prevent the bringing in of dressed stone for use on the new Lutheran College at Hamline from the Sandstone quarries.

The St. Paul, Minn., stonemasons have completed a permanent organization: N. I. Nelson, president; Peter Bloomquist, vice-president, and John Quinn, secretary.

The Bedford (Ind.) Stone Company has asked for a receiver. The company has succeeded in freeing itself of $50,000 indebtedness but desires to quit business and suit of a friendly nature has been brought for that purpose.

A union of stonehaulers, with 145 members, has been organized in Chicago.

The Momence (Ill.) Stone Company has been organized to engage in the business of crushing stone for making roads. Robert Pitman, manager.

The Northwestern stone crushing plant at Cedar Rapids, Iowa, has resumed operations under management of Superintendent Storm.

Henry McNamee and George S. Coutant, of Kingston, have purchased a stone quarry on Fly Mountain, Eddyville, N. Y., from Benj. Turner, and have started a stone crushing business.

The Western Stone Company, of Chicago, has voluntarily advanced the wages of its 1500 employes 35 per cent.

The Wilburtha Brownstone Company, of Wilburtha, N. J., has been incorporated to quarry stone. Capital, $2000. Incorporators: Annie E. McCarthy, Florence McCarthy and Peter Backus.

Joseph F. Carew's freestone establishment on Girard street, Boston, has been destroyed by fire. Loss on machinery, stock and building, $7000.

Messrs. Rink and Gaffney have started their stonecrusher in the city quarries at Rockford, Ill.

The Supreme Court of Indiana has affirmed the decision of the Circuit Court of Monroe county in the case involving the property of the Morton C. Hunter Stone Company. In 1897 the property of the company was not assessed by the County Board of Review, owing to the failure of certain officers to present the schedule. On learning of the omission the county assessor assessed the company's property at $17,000. The company brought an action to enjoin the collection of the taxes for that year, on the ground that the property had not been assessed by the proper authorities, and, therefore, was illegal. The Circuit Court refused to issue the injunction.

The Bedford stonecutters demand an increase in wages from 35 to 40 cents an hour.

The Findlay (O.) Crushed Stone Company has closed a contract for furnishing 10,000 tons of crushed stone for road-making in Van Wert, Ohio.

J. E. McEntyre has a force of fifty-two men at work at Denver, dressing stone for the new mint building.

Marble and Granite

Robert Graham, of the Northwestern Granite Works, St. Cloud, Minn., has secured a contract for 60,000 feet of granite curbing for St. Paul. The company also has assurances of contracts in Minneapolis to bring the total quantity to be gotten out at this time to somewhere between 12,000 and 14,000 feet of the curbing.

W. G. Freedley, of Philadelphia, has ordered new machinery for his quarry at Freedleyville, Vt., and will resume operations on a large scale.

Booth Brothers & Hurricane Island Granite Company have secured from the United States government contracts for the armory and boathouse at Annapolis. The amount of the contract is $793,000. The granite will all be quarried at the Waldoboro (Me.) quarries. These two contracts call for 150,000 cubic feet of granite, or 1000 carloads; it will take two years to fill the contracts. The company also has the contract for the granite to be used in the new bridge for the Maine Central railroad at Thomaston.

The Maine Red Granite Company is getting out at Washington, Me., eighteen polished red granite columns for a Catholic church at Tampa, Fla.

The Chase Granite Company, of Blue Hill, Me., has a crew of granite cutters at Somes Sound, cutting some large stone that was called for in a recent contract.

A split has taken place in the Granite Cutters' Union at Rochester and a new organization, composed nearly wholly of Italians, has been organized.

The marble yard of Messrs. Hugh Sisson & Sons, at the corner of North and Monument streets, Baltimore, has been purchased by the Pennsylvania Railroad Company, the consideration being, it is said, $200,000. The railroad company will build warehouses, freight sheds, etc., and the Sisson company will move elsewhere.

The Galesville (Wis.) Marble Works is getting out ornamental stone for a new Lutheran church at Ettrick.

The Supreme Court of Rhode Island has appointed Lorin M. Cook, of Providence, receiver of the Smith & Newell Granite Company, of Westerly.

The marble works of Beggs & Son, Anderson street and Church avenue, Allegheny, has been damaged to the extent of about $12,000 by fire.

The Georgia Marble Finishing Works, of Canton, Ga., is installing three gang saws and a rubbing bed; it will also erect a 100-foot annex, and place machinery which will enable it to double its output.

Alex. Masterson, the pioneer in marble quarrying at Tuckahoe, was shot and killed in New York on May 3 by James Neal Plumb, a well known man about town. Plumb declared that Masterson had hounded him for years and had turned his family against him. Masterson was 72 years of age, was a retired banker living at Bronxville, and was a Scotchman by birth.

The Atlanta Journal says: "The new St. Charles Hotel at New Orleans," said an Atlanta man, "is built of Georgia marble. The green marble pillars in the arcades are dreams of finished beauty. The hotel has over 600 rooms, and is as handsome as the handsomest in this country—bar none. A more graceful tribute than Louisiana has paid to Georgia, in thus availing herself of our resources, could hardly be imagined. In putting Georgia marble to such beautiful use she teaches us a great lesson. In order to learn it at a glance Georgians have but to look at the Atlanta customhouse, trimmed in Maine granite, and the State capitol, built of Indiana limestone, and then turn to the St. Charles Hotel at New Orleans, which the Goober Grabber State has adorned by handing to the Pelican State the finest specimens of marble to be found anywhere in the Union."

The marble works of L. H. Boody, at Rupert, Pa., was destroyed by fire.

Harry Bailey, of Urbana, has purchased the interest of H. J. Meacham in the mar-

ble and granite firm of Rock & Meacham, at Monticello, Ill., and the firm hereafter will be known as Rock & Bailey.

Hutchinson & Reed have purchased the King City Marble Works and will remove them to Albany, Mo.

O. H. Brosius has established a new marble works at LaBelle, Mo.

A. J. Ennders, formerly proprietor of the Coloma Marble Works, has purchased the Benton Harbor (Mich.) Marble Works of H. W. Kent.

Benjamin H. Jones and Thomas and Charles Caldwell have incorporated the Benjamin H. Jones Marble and Granite Company, which will have its place of business at Fourth and Monroe streets, Wilmington, Del.

The N. O. Nelson Manufacturing Company, of Leclaire, Ill., is erecting an additional factory building for the dressing of marble, slate and stone.

W. W. Birkett, has opened a granite and marble business at Belvidere, Ill.

John Salladin, proprietor of the Pulaski (N. Y.) Marble Works, is dead. Aged, 62 years.

Charles A. Davis, a marble dealer of Fulton, N. Y., has purchased the Advent church property, adjoining his establishment, in order to accommodate the growth of his business.

Notes from Stone Trade Centers.

Henry Henley, J. E. Henley and James B. Wilson, of Bloomington, Ind., have incorporated the Clear Creek Stone Company. Capital, $50,000. The company will open quarries in the Crafton district, on what is known as the Rhorer farm. They will quarry and prepare stone for the market, operating a steam mill in connection with their quarries.

Bayfield, Wis., reports little doing in its brown stone quarries.

A ledge of stone about 150 feet in length was broken out at the quarry of William Samp Beloit, Wis., by a blasting charge of 840 pounds of powder.

Hamilton, Ont., is discussing the advisability of the purchase by the city of the Springer quarry. The property can be had for $7000, and the plant is said to be worth $1000.

The great monolith at the Prentice quarry, Houghton, Wis., so widely advertised, has been cut into blocks for building purposes.

Col. J. D. Quinn, owner of large quarries at Denison, Texas, is dead, at the age of 73 years.

George E. Currie, the paving contractor of Detroit, has purchased the city plant of the Michigan Stone & Supply Company, at the corner of Third avenue and Holden road.

William Norris has opened a stone crushing plant at Findlay, Ohio.

The Findlay (O.) Crushed Stone Company has secured a contract to furnish 50,000 tons of crushed stone to be used on the roads of Paulding county.

Forbes & Berger have received the contract for the stone trimmings of the new U. B. church at Chambersbury, Pa. The job will require thirteen carloads of stone.

The Carthage Dimension and Flagstone Company, recently reorganized, will take up the business of the late W. J. Gilfillan, flagstones, and will also handle all cut stone turned out by the Carthage Marble & White Lime Company.

A. A. McGee has opened the stone yard in South Westeport, Ind.

The Phenix (Mo.) Stone Company, W. Delarue, secretary and general manager, has secured the contract to furnish 500 carloads of building stone for a railroad bridge in Arkansas.

An eight-ton boulder from the quarry of Field & Wild, at Quincy, Mass., has been placed in position between Lincoln and Lexington to mark the spot where Paul Revere dismounted on the occasion of his memorable ride.

Cements and Putties for Masons' Use.

Dissolve alum in water until the fluid will not dissolve any more, then mix with this sufficient plaster of paris to make a stiff dough and bake it; when baked hard and dry grind it to powder, and for use mix with water as wanted, and apply it like plaster. Various pigments may be mixed with it (while in the dry state, after baking and grinding) to make the cement imitate the color of any kind of marble it is required to cement or join. Joints made with this compound can be polished as smooth as glass, and thus the joint in the marble work may be rendered imperceptible.

The Slate Trade

Slate Shipments from Pennsylvania

During the year 1898 the Bangor region shipped 308,766 squares or roofing slate, and the Lehigh region 356,597 squares, a total of 665,363 squares. In the first quarter of 1899 the shipments were 47,557 squares from the Bangor region, and 59,455 squares from the Lehigh, a total of 109,012 squares.

Slate in Canada

The slate quarried in Canada comes chiefly from the Cambrian rocks in Quebec, although agillites of various colors are known to exist in other parts of the Dominion. British Columbia has had two companies operating quarries by horse and hand power in recent years; one at Nanaimo, in Vancouver, and one at New Westminster. In Quebec at one time there were three concerns working quarries in Richmond County; one at New Rockland and two at Richmond, which produced principally roofing slates. In recent years, however, only one large concern has supported the industry, says the "Engineering and Mining Journal."

One of the reasons why Canadian production has been small is because slate can be imported very cheaply from the Vermont region in the United States, notwithstanding the duty.

During the years 1894 to 1898, the total production of slate in Canada was $271,411; the imports, $119,366; the exports, $13,097, and the approximate consumption, $377,680.

To encourage the home industry the Canadian government has imposed a duty of 25 per cent. on all importations of roofing slate (not exceeding 75c. per square), school slates and pencils, and 30 per cent. on mantels and other manufactures of slate. Notwithstanding this tariff, however, the domestic output has diminished 46 per cent. during the past five years and the consumption has fallen off nearly as much. On the other hand, a small export trade was built up, but in the last two years little or nothing has been done in this line.

The total production of slate in Quebec in 1898 was 3432 short tons, valued at $37,374, as against 5208 tons, valued at $37,600 in 1897. The New Rockland Slate Company is the only one working slate quarries in Quebec. The company opened its property 35 years ago, and in 1898 it employed 85 men regularly; 50 in the quarry and 35 in the shops for preparing the slate for market. The average yearly output of roofing slate is used in Ontario. The National Slate Company, a small concern, abandoned its quarry in 1898, leaving the New Rockland Slate Company the only one in the field.

Of the total imports into Canada in 1898 the United States furnished $21,762, or 87 per cent.; Germany, $2,573, or 10 per cent.; Great Britain, $362, or 2 per cent., and China and France the balance. The United States shipments consisted of 1150 squares of roofing slate, valued at $3475, or $2.30 per square; 302,744 pieces of school slates, worth $10,334; mantels, valued at $554; pencils, $447, and all other manufactures of slate, $6952. In comparison with previous years, the imports from the United States show wide fluctuations, more particularly in roofing slate. In 1894 the total imports were 3067 squares of roofing slate, valued at $12,568; in 1895 they dropped to 1470 squares, valued at $5276, but in 1896 the imports rose to 2891 squares, valued at $9948. On the other hand, the imports of school slates have grown from 140,139 pieces, valued at $4307; in 1894, to 302,744 pieces, valued at $10,334, in 1898.

The small imports from Germany in 1898 included no roofing slate, but a small quantity of school slates. Little or no roofing slate has been imported from Great Britain for a number of years past.

The imports from China in 1898 were 30 squares of roofing slate, valued at $102—

noticeable only as coming from an unusual source.

The roofing slate imported went mostly to Ontario and Quebec; the school slates to the same provinces; the mantels to Nova Scotia, Manitoba and New Brunswick; pencils to Ontario and Quebec, and other manufactures of slate principally to the same provinces.

Export Trade in Slate

During the month of March there was sent from New York $96,536 worth of various kinds of slate, as against $91,889 in the same month last year, and $37,622 in March, 1897. For the quarter ending March 31st, 1899, the exports from New York amounted to $221,557, showing a decrease of $7294, as compared with the same period last year, but there is an increase of $8253 over the first three months of 1897. The slate exported from this port in March, 1899, as compared with February showed a falling off in the movement to the United Kingdom and Australasia. Among the countries receiving slate during the month were the United Kingdom, $61,909; Germany, $21,320; Belgium, $3325; Denmark, $2804; Australasia, $2450; India, $2065; Holland, $920; and Africa, $489. The shipments of roofing slate to the United Kingdom during March aggregated 283 carloads, equivalent to about 14,150 squares, chiefly to London. Those to Germany amounted to about 95 carloads, or 4750 squares, mostly to Hamburg. Denmark's receipts were principally roofing slate, while Belgium imports consisted of 319 boxes of slate slabs. About one-half of Australia's imports was roofing slate. A small quantity of roofing slate was also sent to the West Indies. Other manufactures of slate went to Holland, Africa, Newfoundland and Norway, and of these much the larger part was school slates.

The roofing slates exported from New York to the United Kingdom in March had an average invoice value equivalent to $5.21 per square, as against $4.41 in the previous month and $5.06 in January. The shipments in March to Germany had an average value of $5.45 per square, or 55c less than the previous month, but as compared with January there is an increase of $1.45 per square in March. The exports to Denmark had an average value of $5.67 in March, against $4.67 in January.

The several hundred employes of the Chapman Slate Company, at Chapman Quarries, Pa., have been notified of a raise of wages ranging from 15 to 20 per cent.

A charter has been granted to the National School Slate Company, which will market the product of the three largest school slate factories in the world—the Hyatt factory at Bangor and the factories of the American Slate Works and of Edward L. Krause, of Slatington. The officers of the company are E. L. Krause, president; J. S. Moyer, treasurer, and A. N. Brown, secretary. The business of the company will be carried on at Bethlehem, Pa.

The Carbon Slate Company will operate three new quarries at Slatington, Pa., in connection with the two old ones, making five in all, employing from 100 to 200 men.

The National Slate Company, of Bethlehem, has been granted a charter: capital $5000.

The North Albion slate quarry and eighteen acres of land, in Washington township, Pa., has been sold at public sale to E. P. Buzzard for $800.

The sheriff has sold the quarry and property of the Bangor (Pa.) Superior Slate Company to G. W. Mackey, trustee for the bondholders and first judgment creditors of the company, for $25,000.

The following officers have been elected by the Argyle Slate Company, owners of the former Acme quarry at Wind Gap, Pa.: William Harding, Sr., president; G. W. Mackey, vice-president; N. A. Litchfield, secretary; Conrad Miller, treasurer.

George Snooks, Oscar Wolfe and several other residents of Bangor, Pa., have leased the Danielsville Slate Company's quarry and factory. Oscar Wolfe will be the manager.

There has been incorporated in Pennsylvania the Park Slate Company, of Wind Gap; capital, $5000. The incorporators are Fitzgerald, Speer & Co., A. Danville and W. H. Budge, of Pen Argyl; J. E. Stofflet and John S. Roimg, of Wind Gap.

A cave-in at the Pen Argyl Valley slate quarry, at Pen Argyl, Pa., killed three operators.

Monumental News

A monument to the One Hundred and Fourteenth Pennsylvania regiment, the Collis Zouaves, was dedicated this month at Chancellorsville. The monument is a large granite stone, taken from the quarries at Fredericksburg, Md. The base is 5 feet long and 14 inches high, and the die 3x4 feet. Both die and base are rough finished on the margin.

In August a monument will be erected at Front Royal, Va., to the men of Mosby's command, who were hanged in the streets of Front Royal, by order of Gen. Custer. The monument is being made at Barre, Vt.

A monument to the dead of Col. Ray's immunes will be erected at Macon, Ga. More than $2000 have already been raised for the purpose.

The Canadian government will spend $3000 to erect monuments on the battlefields at Burlington Heights and Stony Creek.

The statue of Gen. Grant, which was unveiled in Fairmount Park, Philadelphia, is the work of Daniel Chester French and Edward C. Potter; the former being the sculptor of the figure and the latter of the horse. The artists chose for their motif a moment when Grant was surveying a battlefield from an eminence. The statue is of heroic size and is cast in bronze. The pedestal is 5 feet 6 inches by 12 feet 6 inches, and is made of Pink Jonesboro granite. It is supported by a step surrounding the molded base of the monument.

The monument to be erected in honor of the Hudson County, N. J., soldiers and sailors will be erected in the main pathway in front of the City Hall at Jersey City.

A handsome monument for Santiago, Ia., has been completed at the Luverne (Minn.) Stone and Marble Works, by James Horne. All of the stone was taken from the quarries in Luverne.

The Masons will erect a handsome monument in Lakeview Cemetery to the memory of Past Grand High Priest John L. Lewis, of Penn Yan. James Ten Eyck, of Albany, is chairman of the committee.

The Bernard E. Bee Chapter of the United Daughters of the Confederacy will erect a handsome monument, 40 feet in height, to the Confederate dead at Travis Park, San Antonio, Texas.

Fargo, N. D., is raising money for a monument to its soldiers, who have died in the Philippines.

C. H. Moore & Co., of Montpelier, Vt., have shipped a soldiers' monument to Salamanca, N. Y. It has a 12-foot base and is over 100 feet in height, being surmounted by a statue of a soldier at "parade rest."

Pittsburg, Kans., will erect a monument in honor of the Kansans, who died during the recent war.

The monument to the North Carolina Confederate dead in Stonewall Cemetery, at Winchester, Va., will be unveiled in September.

A bronze statue is to be placed over the grave of Jefferson Davis, in Hollywood Cemetery, Richmond.

Watertown, S. D., is raising a fund for the erection of a monument to its soldiers who lost their lives in the Philippines.

A monument to Gen. Lafayette is in course of erection on the Brandywine battlefield. It will be 78 feet high and 28 feet square at the base, and will be made of Brandywine Granite.

W. G. Potter & Son., of Geneva, N. Y., are erecting a granite monument 40 feet high, 12 feet 8 inches square at the base, in Oneida county, for a wealthy family from Chicago.

John G. Hammer, of Williamsport, Pa., has received the contract for a monument of Concord grey granite, to be erected in that city, in honor of Chaplain Rick.

Daniel C. French, the noted New York sculptor, is modeling a statue of ex-Gov. J. S. Pillsbury, of Minnesota. It will be erected in front of the University at Minneapolis.

A movement is on foot to raise money

from the Sunday-schools all over the country for a monument over the grave of John R. Morris, the veteran Sunday-school worker of Brooklyn, who died a few months ago.

C. J. Crosby has purchased a half interest in the marble and monument business of Andrew Hynne, 321 Jay street, La-Crosse, Wis.

Unknown parties entered the marble and granite yard of James Wentz at Centerport, Pa., and poured a dark lubricating oil over all of the tombstones and monuments The damage is $1800 to $2000.

The monument just dedicated by Kentucky, at Chickamauga Park, occupies one of the choicest sites in the park and is worthy of special note from the fact that it is the first monument erected in this country to the memory of both Confederate and Union soldiers from the same State. The monument is a magnificent shaft of granite, surmounted by a bronze globe, resting on cannons pointing outward, and, standing over all, a bronze statue of the goddess of war, with a high-lifted sword in one hand and a torch in the other, pointing downward.

The Ontario (Canada) Historical Society is raising a fund for the erection of a monument at Niagara, to the memory of Laura Secord, the Canadian heroine, who, after the battle of Stony Creek, escaped from Indian captors and walked twenty miles, ten of which were through the enemies lines, to warn Lieut. Fitzgibbon of an intended midnight attack by the Americans.

The Wisconsin Legislature has appropriated $5000 for a monument to be erected in Lancaster to fittingly mark the last resting place of Nelson Dewey, the first governor of Wisconsin. Gov. Scofield, Senator Baxter and Assemblyman McDonald are a committee to direct and control the erection of the monument.

The Newcastle (Ind.) Marble Company is erecting a handsome monument at Middletown, Ind., over the grave of Monroe Strickler.

The design of Caspar Buberl, the New York sculptor, has been accepted for the statue of Admiral Semmes, to be erected at Mobile. The statue will be in bronze, eight feet in height, mounted on a granite pedestal, thirteen feet in height.

Mr. F. W. Rejahl, of Belle Plaine, Ohio, has been awarded the contract for the soldiers' monument to be erected at that place. The base will be of Barre granite and the figure of Bedford stone.

A. R. Robertson, of Athens, Ga., has been given the contract for a handsome monument to the late Rev. Charles W. Lane, of that city.

The Catholic Knights, of Columbus, O., are raising funds for a handsome monument to be erected over the grave of the late Bishop Watterson.

The plans of Architect D. H. Burnham, of Chicago, have been accepted by Z. G. Simmons for the soldiers' monument he will erect at Kenosha, Wis. The monument will be 61 feet high and will be built on a circular granite terrace four feet above the park level and ornamented with eight buttresses, on which are placed granite cannon. The shaft is fluted granite and is thirty-six feet high, surmounted by a Corinthian capital, on which stands a ball, crowned by a figure of "Winged Victory." The monument will be erected in Central park, near the public library, and not on the lot purchased originally for a monument site. Mr. Simmons estimates the cost at $13,000.

James H. Barnes, of Binghamton, N. Y., has been awarded the contract for a monument to be erected over the grave of the late State Senator Edmund H. O'Connor. It will be in the form of a sarcophagus.

The design of Henry T. Plasschaert, the Philadelphia sculptor, has been accepted for the monument to Americanism to be erected at Allentown, Pa. The principal group will consist of a Union and a Confederate soldier, standing on guard beneath a half-furled American flag. Below the pair will appear the words: "One Flag, One Country." Above that group are four bas-reliefs on the side of the monument, one representing a cavalry charge, one a marine view showing the battle between the Alabama and the Kearsarge, one showing the review of the Union troops by President Lincoln, and one containing the emancipation proclamation. On the four corners are heroic figures of a sailor, a cavalryman, an artilleryman, and an infantryman in the Regular Army, while at the top of the great, tall shaft stands a statue of Columbia.

Codington county, S. D ., will erect a monument to Lieut. Adams, who was killed in the Philippines.

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WE KNOW Who wants to buy. Who wants to sell. What they want to buy. What they want to sell. WRITE US.

By a vote of the representative citizens, the city of Battle Creek, Mich., has decided to erect a $10 000 soldiers' monument in Monumental Square, that city. Suitable designs are asked from artists and monumental firms. Address F. J. Kellogg, General Secretary of the National Volunteer Reserve of the State of Michigan, 110 E. Main Street, Battle Creek, Mich.

Rome, N. Y., has raised a fund for the purchase of a statue for the soldiers' monument.

Tennessee will erect a statue to Sam Davis, a Confederate spy, who was hanged, after refusing pardon, if he would betray his friend.

The Illinois monuments at Chickamauga park will be dedicated on November 23d, 24th and 25th, the anniversaries of the battles of Orchard Knob, Lookout Mountain and Mission Ridge. The monuments cost about $50,000.

The John Ball post, G. A. R., has secured a number of headstones for the unmarked graves of soldiers in the cemeteries at Winona, Minn., Trempealeau, Wis., and

Moran Drill Connection,
.....ALL METAL.
EFFICIENT. RELIABLE.
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Moran Flexible Steam Joint Co.,
(INC'D.)
151 Third St., Louisville, Ky.

Write for circular and reduced price list.

Minneiska, Minn. They were cut at West Stockbridge, Mass.

A monument will be erected in Jackson park, Chicago, to the late Simon Pokagon, chief of the Pottawatomies. It will consist of a statue of Pokagon in chieftain's attire and there will be four bas-reliefs representing events in the history of the Indian days of early Chicago.

Henry P. Rieger, of Baltimore, has designed a monument to be erected in the Naval Cemetery at Annapolis, in honor of James Pinkney, colored, who lost his life on the battleship Maine. The monument will be of marble, 17 feet high, with a granite base.

The Daughters of the Confederacy will erect a monument over the unknown Confederate dead in the cemetery at Germantown, Pa. There are 224 Confederate dead buried in this cemetery. Mrs. J. T. Halsey is the president of the Gen. Dabney H. Maury Chapter, which has the matter in charge.

A monument of Paul Hamilton Hayne, the Southern poet, is to be erected at Augusta, Ga. Congressman Fleming is secretary of the association in charge.

The Baltimore Chapter of the Daughters of the Confederacy have been granted permission to erect a monument to the Confederate dead in Druid Hill Park, Baltimore.

Northampton County, Pa., will erect a $14,000 monument to its dead soldiers and sailors.

Duboise County, Ind., is trying to erect a $5000 monument over the grave of Jesse Stork, at Holland; Stork being, it is claimed, the first Indiana soldier killed in the Cubar war.

The Fredericksburg (Va.) Monument Association has expended $15,000 on the monument to Mary Washington, mother of the first president, and only $5000 is necessary to complete the work.

Stoughton, Mass., will erect a stone monument on the site of the first house erected in that town.

The citizens of Vermont have started a movement for the erection of a statue to Admiral Dewey, opposite that of Ethan Allen at the entrance of the state house in Montpelier.

North Brewer, Me., is raising money for a soldiers' monument.

Wilson MacDonough has been commissioned to prepare a life-size bronze of Edgar Allen Poe. It will be mounted near Poe's home in Bronx Park, N. Y. Mr. MacDonough has also completed a bronze bust of Thomas Paine. This will be placed in position on May 30th on the monument which marks Paine's grave in New Rochelle.

All of the children in the schools of Mississippi have contributed to a monument to be erected in honor of Irwin Russel, the young Mississippi poet.

It is expected that the statue of Gladstone, made by Mr. Adams-Acton, will be ready for unveiling at Blackburn, England, on November 1st. It is a pure white Carrara marble, 10 feet high. The pedestal will be of red Peterhead granite, 20 feet in height.

George J. Zolnay, the New York sculptor, has modeled a tablet 5 feet long and 3 feet wide in memory of Miss Winnie Davis. The tablet will be cast in bronze by the Henry Bonnard Co., and be placed on the walls of St. Paul's Protestant Episcopal church in Richmond, Va., and is the gift of Ambrose A. Maginnis, of New Orleans.

Lichen on Stone Buildings.

The green or black covering which forms on light-colored stone after some time, has been found by Dr. Frunling to be a lichen, and if once developed is hard to remove. Its formation, however, may be prevented by painting the stones with a diluted sulphide of potassium solution at intervals of one year. Leitzmann has attempted to wash off the houses with hydrochloric acid and found that this was effective for three to six years.

Road Machinery Wanted.

Anderson County, Tenn., will purchase a stone-crusher.

The council of Claysville, Pa., is considering the purchase of road machinery.

Jasper, Ind., will purchase a road scraper.

Craston, R. I., will purchase a road roller.

John Clark, Elwood, Johnson and Sam Hull, of Liberty, Ind., have been appointed a committee to purchase a stone crusher.

The Brownell Construction Company, of Chicago, has been awarded the contract of constructing forty-two miles of stone road in Lake County, Ind., its bid being $167,500.

Nelson D. Hodgins, of Marquette, Wis., has been awarded the contract for broken stone for the government breakwater at that place.

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Limes and Cements

Grain Elevators Built of Cement.

A dispatch from Duluth, Minn., says: It is probable that this city will soon have the largest grain elevator in the world, with a storage capacity of 3,600,000 bushels under one roof. Not only is this new structure to be notable for its size, but it is also to be on a plan new to America. The banks of the Danube in Roumania are dotted here and there with grain elevators of small size built of concrete. The Peavey Grain Company, the largest handler of grain in the world, has been investigating the system and has decided to utilize it in its new elevator in this city. The Peavey company now has more grain storage than any other concern in existence and is adding to it every year. It has in operation here elevators of wood that will hold about 7,000,000 bushels, has the same capacity at Minneapolis, and 3,000,000 at Chicago, besides some 9,000,000 bushels more at Kansas City, Omaha and other centers of the West. Besides it has in operation about 500 country elevators of an average capacity of 40,000 bushels, making a total capacity, both terminal and country, of about 45,000,000 bushels. All this is the growth of less than ten years, and almost entirely the individual work of one man, Frank H. Peavey, of Minneapolis, who is still a young man.

Mr. Peavey has been investigating the system of Roumania, and has been so much impressed that it is to be adopted here. These structures cost considerably more than wood. Probably in the elevator to be built the difference will be not less than $400,000, but the gain in insurance is so great that there is an actual saving. Insurance in wood houses is about 1½ per cent., and it is impossible to build structures over a certain size, as no insurance concerns in the world will carry the tremendous risks aggregated under one roof when that roof covers millions of bushels of wheat. In structures built of concrete and roofed with steel or tiles there need be no insurance, and the elevator owner can get an additional profit, or if it is decided to carry policies they can be had in plenty at ¼ of 1 per cent. Steel elevators, such as that of the Great Northern road at Buffalo, have the same advantage in point of insurance as those of concrete, but they are much more costly, and there is danger that the grain will sweat in the bins and be ruined thereby. The contract was let last week for steel and the erection of the Great Northern's elevator here, with a capacity of 3,000,000 bushels, and the contract price was $800,000. This is not including foundations, machinery, docks and many other items. Wood houses of the same capacity might be constructed entire for $600,000.

The Peavey elevator's floor plan will be that of a great honeycomb, and additional capacity can be given, as the bee adds to the capacity of its comb, by putting on more cells. These cells will be built to a height of some seventy feet, tunnels built under them to transfer the contents, and a roof put over of tile or metal. The concrete is in the form of slabs of Portland land cement. The slabs are erected to the required height and the house is ready to receive its contents. The cement elevator may be built of any desired length or width to fit any ground, and can be added to with ease. It can not burn, and grain can be kept therein with greater safety from heating than in wooden or steel elevators.

"We are aiming to secure the very best and most advanced method of grain handling in this house," said Mr. Peavey, in speaking of his plan, "and if the cement elevator proves the best, as we think, we shall use it and have the most up-to-date and complete storage for grain in the world. My experts have been on the Danube for weeks looking into this system and have made exhaustive reports thereon. Electrical experts are now being consulted

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on plans for operating the entire system, at Duluth, 12,000,000 bushels, by electricity derived from some central plant. The most distant of these houses will be five miles apart. The old plan of operating an entire elevator by one steam engine will be thrown aside with us and electric motors set where they will be needed. Each leg, each belt, each platform, etc., will be run by an independent motor, and the cost of power will be greatly reduced in consequence."

Foreign Cement Trades Market Report

April, 1899.

The cement trade in the United Kingdom and on the Continent continues in a most active condition. Prospects point to demand continuing to outrun production during the present year.

The English mills are fully booked with orders for the home trade, many experiencing a difficulty in supplying the most urgent requirements of their customers. Prices in sacks rule 2s. 6d. to 5s per ton higher, and in many parts of the country there is extreme difficulty in securing adequate supplies of cement for current building jobs. The abnormal consumption on public works, activity in the building trade, and the general healthy tone of the Export Trade, are strong factors in the present position.

Imports of cements from the Continent to the United Kingdom continue, but are somewhat checked by the advanced prices now asked by the German and Belgian works.

For export, the Thames and Medway works are well supplied with forward contracts at full rates. The volume of export trade for the first three months of the year was rather below normal, viz., 77,699 tons, as compared with 84,556 tons in 1898. Excluding, however, the United States (to which exports from Great Britain have fallen from January-March, 1898, 9072 tons, to January-March, 1899, 1913 tons), consumption in foreign markets has improved—South America, India and South Africa bought freely of late.

We quote as follows:

First-class brands, 6s. 9d. to 7s. 6d. per barrel f.o.b. London.

Good merchantable brands, 6s. 6d. to 6s. 9d. per barrel f.o.b. London.

In Germany the cement works are all actively employed. Inland consumption (including adjacent markets in Eastern Europe, such as Austria, Hungary, etc.) will probably exceed the equivalent of 10,000,000 barrels of 180 kilos. An advance on last year's "domestic" prices is freely paid by consumers.

The production of the mills in North, Middle and South Germany is well sold ahead, and, in fact, for any margin of supply the manufacturers can command their own prices. In most cases the mills are selling reluctantly for export, only accepting sufficient business to maintain their foreign connections, and refusing orders from fresh customers.

We quote first-class brands, such as "Alsen," "Germania," "Hemmoor," "Largerdorf," and "Karlstadt," Ms. 7 to Ms. 7.50 f.o.b. ocean port.

In Belgium the mills are very busy. Inland consumption is large and export inquiries continue active.

The leading artificial cement works are very busy, and are refusing already further orders for 1899. We quote "Jossen," "Norths," and "Derrick" 6s. 6d. to 7s. f.o.b. Antwerp.

The Natural Portland Cement Works are exceptionally active, and large orders for shipment during the year have been booked. Further consumption on public work in Belgium will employ very large quantities of natural cements, varying, according to estimate, from 30 to 40 per cent. of the total production. An advance of fully 4d. to 6d a barrel has been established, and prospects point to a difficulty in supplying all export requirements.

We quote as follows:

First-class brands, 5s. 3d. to 5s. 9d., f.o.b. Antwerp.

Second-class brands 5s. 0d. to 5s. 3d., f.o.b. Antwerp.

In submitting these quotations, we again express a word of warning against offers by unscrupulous suppliers of ostensibly first-class qualities, but which in reality are too often of lower grade than named. We are always willing to give information as to reliable sources of supply.

In conclusion, the general position shows that increased prices have not checked consumption, and that the manufacturers occupy as strong a position to-day as in the summer of last year. In the natural order

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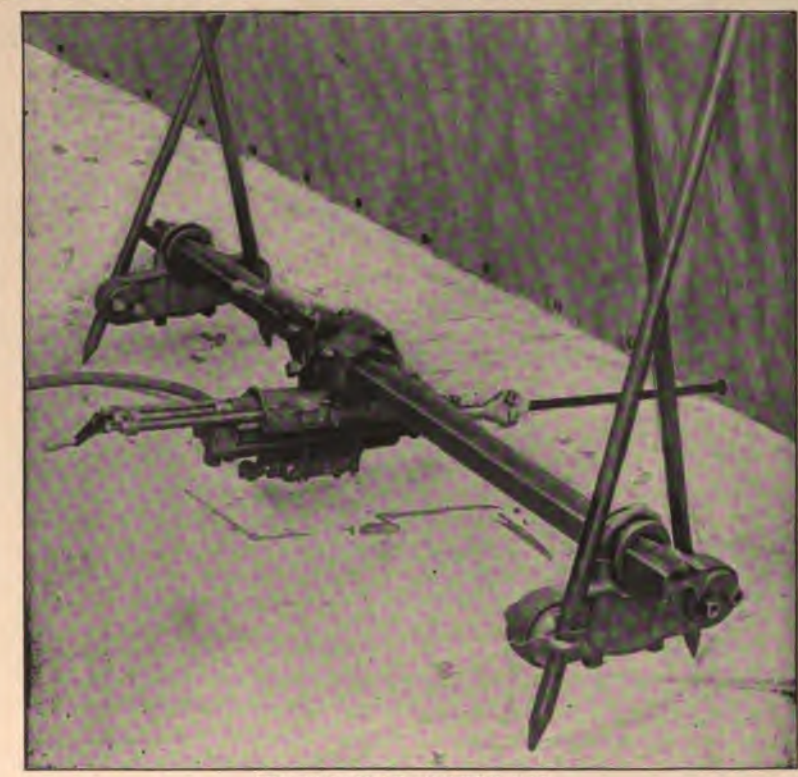

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of things, supply will eventually overtake demand, but the visible consumption for the next two years indicates a continued healthy tone, and a firm maintenance of prices.

It is noteworthy that many of the more important works in Great Britain and on the Continent are turning their attention to improved methods of manufacture, especially in the direction of economy in burning, etc. No doubt, ultimately, a necessity will show itself for cheaper methods of manufacture, and it is encouraging to see the English trade generally alive to anticipating events and directing its attention to more economical but at the same time equally effective methods of production. Having a large experience ourselves of the different methods of manufacture adopted on the Continent and in the United States, we welcome communications from cement makers who are interested in this subject.

TULLOCH & CO.,
4, Fenchurch Avenue, London, E. C.

The suit of the Marblehead Lime Company against the Lakeside & Marblehead Railway Company, has been dismissed at Port Clinton, Ohio. The plaintiff company sought to recover damages for alleged discrimination in freight charges on 937 cars of lime, the amount involved being $24,000. The action was dismissed for the reason that it was brought to collect penalties under the statutes and should have been brought in the name of the State by the prosecuting attorney.

The lime quarries at Menomonee, Wis., will, it is reported, begin operations again, after being shut down for some time.

The White Lime Company, which will make lime at Fosteria, Ohio, has been incorporated. The incorporators are: W. S. Sutliffe, formerly secretary of the Ohio Lime Company, Toledo; C. E. Palmer, general manager of the Dewey Stave Company, Ohio and Michigan; A. Emerine, president of the First National bank; W. A. Jones and M. C. Briggs. The capital stock will be $100,000, and it is expected that one-fourth of this will be expended before the plant will be in shape for work to commence.

The Sturgis Lime Co., of Pierre, S. D., has been incorporated. Capital, $5000. Incorporators: George H. Haitbrink, Mary *Burris*, A. B. Edwards.

The Petoskey Lime Company, of Detroit, Mich., has changed its name to the Bay Shore Lime Company.

The Peerless Portland Cement Company, of Union City, Mich., has been granted a commission for the exclusive manufacture of its cement in Mexico.

The Johannes Lime and Cement Company, of St. Louis, has increased its capital stock from $17,000 to $75,000.

A Portland cement company from Michigan will erect a $100,000 plant, with a capacity of 2000 barrels a day, at Iola, Kans. The town donates one gas well to the company.

The Point lime kilns at Port Clinton, Ohio, have started burning, after being idle for four years.

The Cook & Brown Lime Company, consisting of Ossian Cook, president; F. B. Carter, vice-president; F. E. Waite, secretary; and R. C. Brown, treasurer, have voluntarily increased the wages of their employes 10 per cent., the increase affecting 600 men in the kilns at Oshkosh, Clifton, Grimms, Brillion, Hayten, Eden and Hamilton, Wis.

The Ash Grove (Mo.) Lime Works recently made one shipment of sixty carloads of lime to a single firm in Omaha, Neb.

The lime and stone plant of Harris & Buquo, at Erin, Tenn., including 100 acres of land and a number of tenements, was disposed of at chancellor's sale, to V. R. Harris, for $16,000.

There is a prospect that a Pennsylvania syndicate will open limestone quarries in Virginia, along the lines of the Norfolk & Western railway.

The plant of the Marquette Portland Cement Company, at Deer Park, Ill., will be doubled in capacity from 250 to 500 barrels a day. The first shipment of Portland cement from the mills of Illinois was made several weeks ago.

Topeka, Kas.—It is said that $1,500,000 will be expended by the Santa Fe Co. in improvements during the present year. About $1,000,000 of this amount will go into the tracks and $500,000 in grading, masonry and bridge work.

Washington, D. C.—Sealed proposals will be received at the office of the Commissioners of the District of Columbia until May 27 for the construction of a bridge across Piney Branch in Rock Creek Park.

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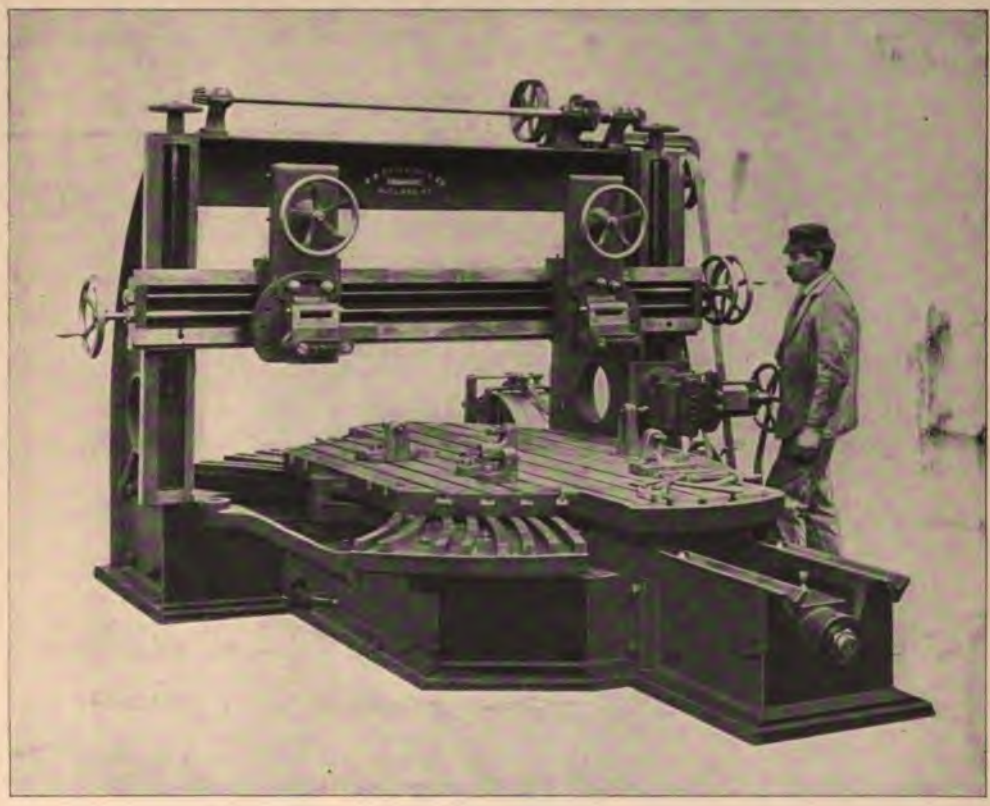

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Contracts and Building

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Sealed proposals for Harbor of Refuge, Milwaukee Bay, Wis., breakwater construction; Racine, Harbor, Wis., crib pier, breakwater, removal of old pier, and dredging; Kenosha Harbor, Wis., pile and crib piers, crib breakwater, removal of old pier, and dredging, will be received at the U. S. Engineer's Office, Milwaukee, Wis., up to noon, May 25. J. G. Warren, captain, engineers.

Sealed proposals will be received at the office of the Supervising Architect, Washington, up to noon, May 22, for the marble and slate work for the main building at the U. S. Immigrant Station, Ellis Island, New York Harbor. Plans and specifications may be seen at the office of Boring & Tilton, 32 Broadway, New York City.

Proposals will be received at the bureau of yards and docks, Washington, until June 10, for the construction of a steam engineering shop and boiler house at the Puget Sound naval station, Bremerton, Wash. Plans, specifications, and forms of proposals can be obtained on application to the bureau, or to the commandant of the naval station, Bremerton. Mordecia T. Endicott, Chief of Bureau.

Sealed proposals will be received at the U. S. Engineer Office, Rock Island, Ill., up to noon, May 31, for construction of dams and shore protection between Winona, Minn., and La Crosse, Wis.; Lansing, Iowa, and Cassville, Wis.; Cassville, Wis., and Dubuque, Iowa; Dubuque and Le Claire, Iowa; Rock Island and New Boston, Ill.; New Boston, Ill., and Burlington, Iowa; Burlington and Montrose, Iowa; Keokuk, Iowa, and Quincy, Ill.; Quincy, Ill., and Saverton, Mo.; Hamburg, Ill., and mouth of Illinois River; for construction of levees between Flint creek and Iowa River, Iowa, and for dredging in Quincy bay, Ill. For information apply to C. McD. Townsend, Captain Engineers.

Proposals for furnishing Portland cement at Lock No. 5, Green River, Ky., will be received at the U. S. Engineer's office, Louisville, Ky., until noon, May 22. George A. Zinn, Captain, Engineers.

Proposals for excaving rock in St. Lawrence River, N. Y., will be received at the U. S. Engineer's Office, Oswego, N. Y., until noon, May 21. Information furnished upon application. Graham D. Fitch, Captain, Engineers.

Proposals for improving Bayou Plaquemine, La., will be received at the U. S. Engineer's Office, Custom House, New Orleans, La., up to noon, June 8. Information furnished on application. James B. Quinn, Major, Engineers.

Proposals for building a brick storehouse at North Point, Md., will be received at the U. S. Engineer's Office, 812 St. Paul street, Baltimore, until noon, May 25. Col. Peter C. Haines.

Proposals for delivering 60,000 tons, more or less, of stone in place in jetties at mouth of St. John's River, Fla., will be received at the U. S. Engineer's Office, St. Augustine, Fla., until May 31. Information furnished on application. W. H. H. Benyaurd, Lieut. Col. Engineers.

Proposals for excavation and removal of Man-of-war Rock, East River, New York Harbor, will be received at the U. S. Engineer's Office, Army Building, New York City, until June 3. Information furnished on application. H. M. Adams, Major, Engineers.

Hotels, Theatres, Depots, County Buildings, etc.

Albany, Ore.—Workmen are tearing down the court house preparatory to rebuilding it in a modern style at a cost of $15,000.

Charleston, W. Va.—Bids will be received June 15 for $60,000 annex to the State Capitol. Harrison Albridge, Charleston, architect.

Chester, Pa.—Ex-Mayor Black is preparing to build a $100,000 opera house at Sixth and Market streets.

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Factories, Irrigation, Etc.

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Chippewa Falls, Wis.—Justice R. D. Marshall, of the State Supreme Court, has decided to build a $20,000 opera house.

Ebensburg, Pa.—Sidney Heckart, of Pittsburg, is preparing plans for an educational institution to be erected on the Ohio River, between Findom and Baden streets, at a cost of $100,000. The institution will be conducted by the Sisters of St. Joseph, Ebensburg.

Elwood, Ind.—A city hall will be erected at once at a cost of $28,000.

Erie, Pa.—Ex-Mayor Black is preparing to build an office and opera house building on Sixth and Market streets. Estimated cost $100,000.

Fargo, N. D.—Hancock Bros. and E. Beeke are preparing plans for the $30,000 Society Building to be erected by Scottish Rite Masons.

Iowa City, Ia.—Bids will be received May 24 for building a jail and jailor's residence at Iowa City. T. L. Crowley, county auditor.

Knoxville, Tenn.—Theatre Manager Staub has a plan on foot to build a new theatre.

Lancaster, O.—The C. & M. V. and the C. H. V. & T. Ry. will build a passenger station at Lancaster. T. R. Scanlon, superintendent, Lancaster.

Larimie, Wyo.—The Union Pacific Ry. will erect a stone depot, 50x200 feet.

Little Falls, Minn.—The Northern Pacific Ry. will build a new depot at Little Falls.

Marietta, O.—The county commissioners of Washington, O., have decided to build a new court house.

Marion, Ind.—B. F. Burke proposes to build a modern opera house.

Merrill, Wis.—The Merrill Hotel Company has been organized with a capital stock of $20,000. A new modern hotel will be built during the summer. The officers are: Mayor J. Thielman, president; N. L. Anson, vice-president; D. M. Phinney, secretary.

Martinsville, W. Va.—Wm. M. Goodrich, of Baltimore, Md., has prepared plans for a stone theatre building to be erected at Martinsville, W. V., by Irwin & Richardson, of Pittsburg. Estimated cost, $25,000.

Menominee, Mich.—Ex-Congressman S. M. Stephenson, the wealthy lumber merchant, is to give the city of Menominee a handsome new library building to be built at his own expense.

New Orleans, La.—The council will advertise for bids for erecting a police jail at Philips and Dorgenois streets.

North Tonawanda, N. Y.—The municipal board proposes to build a $12,000 town hall and jail.

Oil City, Pa.—Daniel J. Geary will purchase the old site and will erect a new opera house.

Owensboro, Ky.—The finance committee recommends the appropriation of $10,000 for a city hall.

Parkersburg, W. Va.—The county court of Wood County June 3 will receive sealed bids for the erection of a court house at Parkersburg. L. W. Thomas, architect, of Canton, O. B. F. Stewart, clerk.

Philadelphia, Pa.—Thos. P. Lonsdale, Manhattan Bldg., Philadelphia, is preparing plans for a $17,000 infirmary to be erected in Montgomery County.

Steubensville, O.—W. H. Lower has purchased a site for the erection of a four-story building, the upper floors to be used for hotel purposes.

Toledo, O.—Plans have been prepared for the proposed Toledo & Detroit Shore Line depot at Adams and Water streets. The building will be 100x70. Plans prepared by Mills & Wachter.

Trinidad, Colo.—The Santa Fe will commence work June 1 for the erection of a new depot.

Walton, N. Y.—The New York, Ontario & Western Railroad will build a new depot here.

Wilkesbarre, Pa.—The city is preparing to build a new court house.

Woodstock, Ill.—M. L. Joslyn will erect a $12,000 hotel building.

Worcester, Mass.—A site has been donated for building a home for the Woman's Club. Mrs. C. C. Baldwin, chairman.

Schools and Colleges.

Auburn, N. Y.—Bids will be received until May 24 for a school house at Auburn. G. B. Ridge, Clerk Board of Education, Auburn.

Baltimore, Md.—The Holy Cross German Catholic Society will build a $25,000 school on West and Light streets. Rev. Chas. Dammer.

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Bement, Ill.—The school destroyed by fire will be replaced with a $25,000 building.

Blooming Prairie, Minn.—Orffen Gilbert, of Minneapolis, is preparing plans for a $12,000 school.

Bryn Mawr, Pa.—The school board has accepted plans for the erection of a $25,000 grammer school.

Columbia, Pa.—The school board proposes to build a $35,000 school building.

Denison, Ia.—A $15,000 high school will be erected.

Detroit, Mich.—Bids will be received May 23 for slate black boards in the Dickinson, Terry and Preston schools. L. H. Chamberlain, secretary.

Durham, N. C.—The citizens have voted to build a $16,000 school.

Grand Forks, N. D.—The directors of the University have decided to build a $15,000 dormitory.

Houghton, Mich.—Work will be commenced June 1 for building a $50,000 school house.

Huntington, W. Va.—The State Board of Regents will receive bids May 20 for a $15,000 annex to Marshall College. Harrison Albright, Charleston, architect.

Jolley, Ia.—Bids will be received June 4 for building additnoal rooms to school. W. N. Steele, secretary.

Kewick, Ia.—Bids will be received May 29 for building a school in District No. 1. Keswick. J. F. Cameron.

Lancaster, N. H.—A $15,000 school will be erected.

Landis, O.—Bids will be received May 27 for building a school in Sub-district No. 2. Chas. Hansbarger, clerk, Landis.

Litchfield, Ill.—Bids will be received May 25 for building a four-room school house. E. C. Thorp, secretary.

Madison, S. D.—Bids will soon be asked for building the $21,000 dormitory at the Normal school.

Mayfield, O.—Bids will be received until June 3 for a new school house here. G. J. Straight, clerk.

Milwaukee, Wis.—The Luthern Synod appropriated $35,000 to build an additional building at Concordia College.

Minneapolis, Minn.—The School Board decided to erect several new schools and additions. The building committtee will immediately consider plans. Estimated cost, $187,700.

Morrisville, Vt.—At the township meeting it has been decided to erect a $50,000 school house.

New Knoxville, O.—Bids will be received May 29 for building a school in Washington township, Anglaize County. H. B. Eversman, clerk.

Northfield, N. H.—The School Board has decided to build a $20,000 school.

Toledo, O.—Plans have been prepared for a $25,000 Waite avenue school.

Washington, Pa.—The Catholic Society will build a $30,000 parochial school, to be completed by September. Rev. Jno. Faughnan, rector.

Washington, Pa.—$50,000 in bonds have been voted to build a school in North Washington.

Wellsbury, Ia.—Bids will be received May 27 for building a school in sub-district No. 6—in District township of Shiloh. W. J. Schurrman, secretary.

Westfield, Mass.—An appropriation has been made of $30,000 to build a normal school. Bids will be asked immediately.

Churches.

Albia, Ia.—The Grace Episcopal Society will build a new church. Rev. Wm. Parry Thomas, pastor.

Ames, Ia.—The St. John's Episcopal Society is preparing to build a new church.

Brookfield, Mo.—The Grace Episcopal Society will build a new church. Rev. J. S. Moody, Kansas City, Rector in charge.

Cohoes, N. Y.—The First Baptist Society has accepted plans prepared by M. H. Hubbard, of Utica, for the erection of a $30,000 church.

Guthrie, Tenn.—The M. E. Society has purchased a site for a new church. Rev. Seay, pastor.

Harlan, Ia.—Bids will be received until May 31 for the erection of a $10,000 church for the First M. E. Society.

Mansfield, O.—The Grace Episcopal Society has decided to build a new church. Rev. A. B. Putnam, rector.

Osakes, Minn.—The Catholic Society has purchased a site and will at once build a church and school house.

Paducah, Ky.—The St. Francis de Sales Catholic Society will immediately build a church. Rev. Herman Jansen, pastor.

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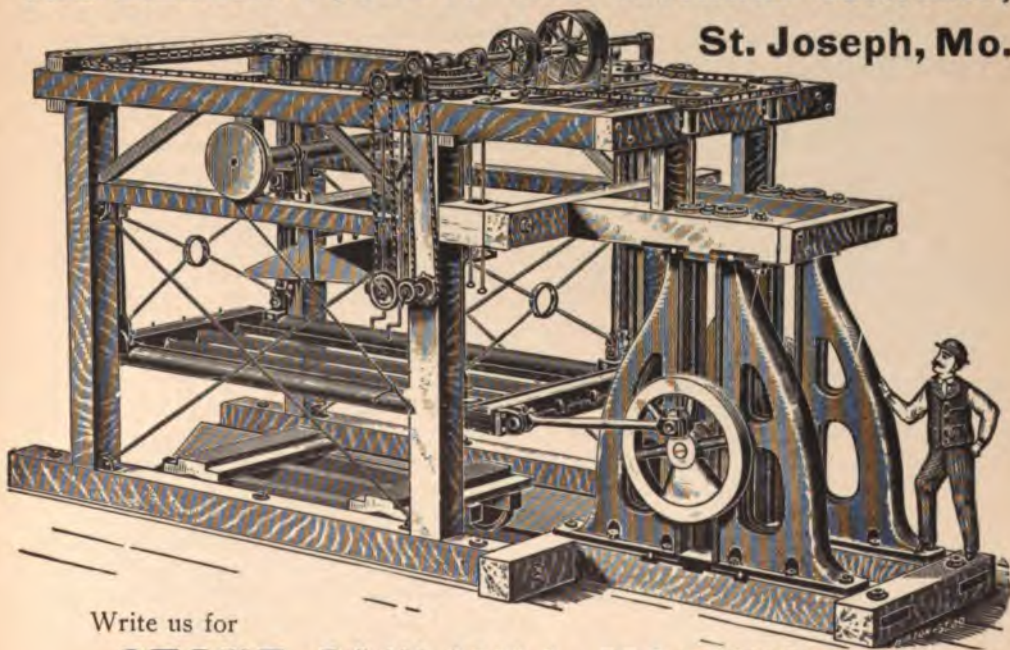

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Philadelphia, Pa.—The Wissahickon M. W. Society is arranging to build a $30,000 church. R. A. M. Viven, pastor.

Pittsburg, Pa.—The trustees of the Third United Presbyterian Society will build a $40,000 church on the old site. Perry F. Smith, chairman.

Pittsburg, Pa.—Bethel A. M. E. Society will build a $25,000 church at Wylie avenue and Elm street. Rev. A. W. Gazeway.

Poughkeepsie, N. Y.—Money has been donated to build a new chapel at Vassar College. Rev. Jas. H. Taylor, president.

Sault Ste Marie, Mich.—Charlton, Gilbert & Demar, of Marquette, have prepared plans for the $20.000 church to be erected by the Presbyterian Society. Rev. G. P. Bates, pastor.

St. Paul, Minn.—Edward J. Donahue has prepared plans for a $25,000 chapel for St. Joseph's Academy at Western and Nelson avenues. Seating capacity 500.

Sandusky, O.—The First Baptist Society has purchased a site for a new church. Plans will now be received for the erection of a $15,000 church.

St. John's, Mich.—The Congregational Society is taking steps towards building a church.

Tama, Ia.—St. Patrick's Society will soon commence work on a new church. Rev. P. J. Carroll, rector.

Business Buildings.

Albany, N. Y.—The directors of the Boston & Albany Ry. have purchased a site at Columbia street and Broadway for the erection of a $30,000 office building. Marcus T. Reynolds, architect.

Aberdeen, S. D.—A steam brick plant will be established by Louis Lager.

Colorado Springs, Colo.—W. P. Bonbright & Co. proposes to build an eight-story business building at Tejon street and Pike's Peak avenue.

Chicago, Ill.—The Chicago & Northwestern R. R. Co. will erect additional carshops at West Fortieth street. Frost & Graufer, 184 La Salle street, architects. Taking bids. Cost, $500,000. Two storage buildings, 40x140 and 80x308. Power house, 100x100. Tank house addition, 80x140. Machine shop, 100x150. Common brick, stone, stone trimmings.

Dallas, Texas.—Oscar J. Rea will erect a large stone business building.

Des Moines, Ia.—Preston & Crocker, of Marshalltown, will be the architects for the mammoth new warehouse to be erected by the Warfield-Pratt-Howell Co. at First and Court avenues.

Detroit, Mich.—Rogers & McFarland, 72 Moffat Bldg., have prepared plans for a $35,000 office building, to be erected by H. N. Leonard, 230 Woodward avenue. Steel, stone and terra cotta, elevator, etc.

Hagerstown, Md.—Oscar Beyer, 56 Fifth avenue, Chicago, is preparing plans for a $75,000 brewery, to be erected at Hagerstown.

Kansas City, Mo.—Hucke & Sexton are preparing plans for a modern office building to be erected at Ninth and Walnut streets.

Lima, O.—The John Hauch Brewing Co. has purchased a church on Central avenue and will remodel the building into a cold storage warehouse.

Minneapolis, Minn.—The Great Northern has decided to build a large new office building opposite its present general offices on Third street. The size of the structure has not yet been definitely decided upon.

Milwaukee, Wis.—Architect H. J. Esser is completing plans for the extensive remodeling of the First National Bank Building both as to the interior and exterior. There will be an entire new front of glazed terra cotta with columns and pilasters. The interior will be finished in marble, and the ceilings will be panal work with ornamental relief. The cost of the improvements will be about $25.000 or $30,000.

Milwaukee, Wis.—Adolph Doctor, 151 Seventh street, is planning the erection of a six-story apartment house at Seventh and Grand avenue. The estimated cost is $60.000.

Milwaukee, Wis.—H. J. Esser, Camp Building, has prepared plans for a telephone exchange building, to be erected at Washington and Hanover streets by the Wisconsin Telephone Co. Estimated cost, $30,000.

Newark, N. J.—L. S. Plaut & Co. will soon erect a six-story iron and brick store building, to extend from the rear of the present Bee Hive along Cedar street and the Morris Canal to Halsey street.

Pueblo, Colo.—The brewing plant owned by Walter Bros. will be remodeled.

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Silverton, Colo.—Several new mining plants will be erected in San Juan County. The Tiger Mining Plant will be equipped with 100-ton smelter. Plans are now being prepared. The Occidental Mining Co. has announced its intention of erecting a large plant this season. The Veta Madre Co. has completed its plans and specifications for the mill to be erected on its property. The Gold Bug Repeal Co. is now figuring on the construction of a large mill on its property. The Red & Bonita Mining Co. has been for some time figuring on the construction of a mill for treating its ores. The Yukon Tunnel Co. has practically decided to erect a mill on its Uncle Sam group.

St. Louis, Mo.—The St. Louis Refrigerating & Cold Storage Co. has been incorporated with a capital of $500,000. This company now owns the franchise and property of the old St. Louis Refrigerating Co. It will rebuild the entire plant, however.

Bridges.

Brewton, Ala.—The county commissioners have decided and directed a civil engineer to prepare plans for one or more steel bridges across the Conecreek River.

Chicago, Ill.—The Great Western Road will expend $500,000 in improving the line between Chicago and Oelwein. Six iron bridges will be included in the improvements.

Clinton, Ia.—The supervisors of Clinton and Scott Counties have decided to build an iron bridge across the Wapsipiuicon River, near McCausland. The structure will be 240 feet long and will have two spans.

Clinton, Ind.—The new wagon bridge to be built over the Wabash River at this place is estimated to cost in the neighborhood of $35,000, and the county commissioners will advertise for bids at once.

Des Moines, Ia.—City Engineer King and assistants are getting out the plans for the Sixth street bridge and for the abutment work of the East Sixth street bridge. It is thought that about $16,500 will be the allotment for the North Sixth street bridge.

Eau Claire, Wis.—On account of defect in plans, bids for the Barstow street bridge abutments were rejected. New plans and new bids are called for.

Gallatin, Mo.—Geo. W. Lockridge, Daviesse Bridge Commissioner, June 5 will let the contract for the building of a bridge across Grand River between Section 10 and 15, township 59, range 26.

Hot Springs, Ark.—There will be let on June 1 a contract for the construction of a highway bridge, to be built for Garland County, over the Onachita River, at Gardner's Ferry.

Hammond, Ind.—The Monon Ry. will build a steel bridge across the river at Hammond and establish yards. Estimated cost of improvement $50,000.

Minneapolis, Minn.—The Great Northern will construct two large bridges over the Cut brook and Two Medicine Rivers at a cost of $75,000 and $80,000. They will replace the present structures east of the summit of the Rockies. Plans and specifications are now being prepared.

Painesville, O.—Lake County commissioners have passed a resolution declaring intention to issue $35,000 of bonds for erecting a bridge near Fairport 320 feet long.

Pekin, Ill.—A new bridge is to replace the old wooden one over Lost Creek north of the city. It is to be built of iron, with stone abutments.

Penn Yan, N. Y.—Two new iron structures are to replace wooden bridges on the Northern Central Railway this season. One is to span the railway leading in Big Stream. The other will cross the chasm at Rock Stream. Four piers will furnish the support for this new bridge, which will be 280 feet long and nearly 100 feet high from the center span to the rocks below. The estimated cost is $85,000. R. Neilson, general superintendent, Williamsport, Pa.

Plymouth, Ind.—The Board of Commissioners of Marshall County, Ind., on June 8 will let the contract for building a bridge and repairing stone abutments over Pine Creek, Polk Township. Frederick Seider, Henry Jarrell and Henry Snyder, commissioners.

South Bend, Ind.—The board has decided to build a bridge across the St. Joseph River at Sample street.

Vera Cruz, Mexico.—The Tehauntepec National Ry. will be controlled by Pearson & Son, the English contractors, after August. Many of the 322 bridges on the line will be replaced with steel structures.

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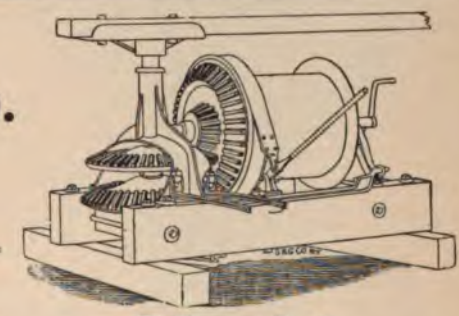

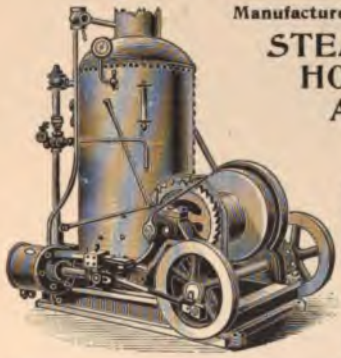

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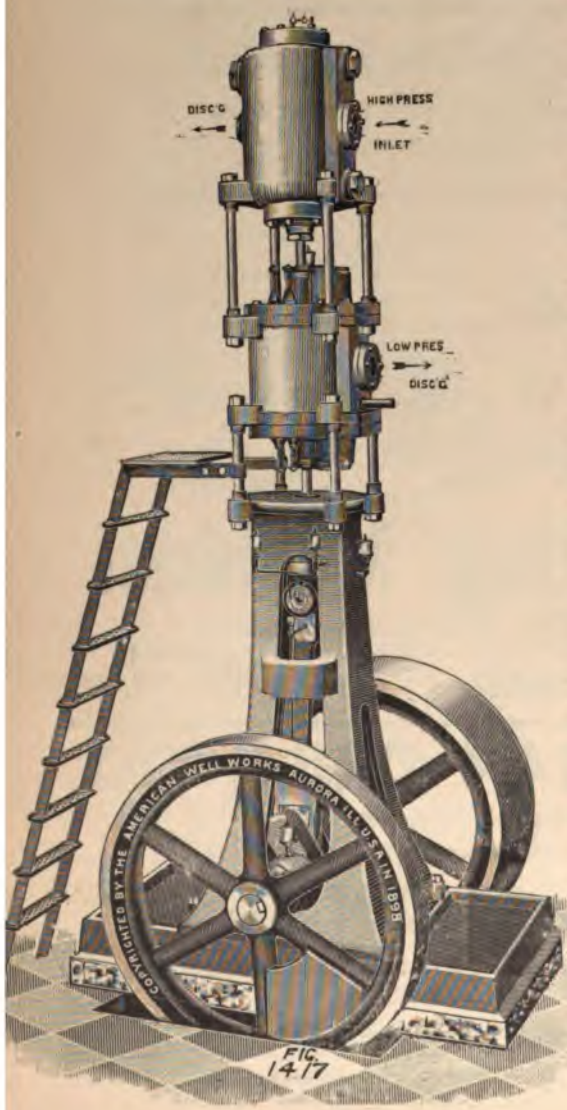
Trade Notes

The Double Compression Vertical Air Compressor, illustrated herewith, is manufactured by the American Well Works of Aurora, Iil. This is extra heavy in construction and is suitable for operating rock drills in quarry work. It is practical for any use, requiring a temporary air pressure not exceeding 200 pounds per square inch, and maintaing a constant working pressure of from 75 to 160 pounds. It is built vertical in order to occupy small space. This machine compresses the air in the lower cylinder to a low pressure. The air then passes through an ample inner cooler, which is provided, wherein it is cooled, and then passed into the upper or high pressure cylinder for final compression. The high pressure cylinder is of smaller diameter than the low pressure cylinder, and a marked saving of power results. The cooling in the inner cooler also saves much power. All bearings are fitted with sight feed oilers to oil without stopping. This style is built in five sizes single, and in five sizes duplex. Anyone who is interested in machinery of this order, and every quarry operator should be, should write to the American Well Works, for their catalogue of pumping machinery, air water lifts, and air compressors.



A. Leschen & Sons Rope Company, of St. Louis, one of the foremost houses in their line of business in the country, are the sole makers of the patent flattened strand wire rope. This has 150 per cent. more wearing surface than ordinary ropes. Owing to the number of wires that are at all times exposed for wear in flattened strand rope for a considerable distance along their respective lengths, a smooth or comparatively smooth surface is presented even whilst new, and the wear is consequently light upon any one individual wire, and the tendency to become brittle is minimized. These ropes are exceedingly flexible and are less liable to the crushing action which frequently takes place with many ropes. They are made up with the wires in the strands and the strands in the ropes laid in the same direction (Lang's Lay). Flattened strand ropes are free from all tendency to spin or kink, hence a

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MARCH	1893
APRIL	1893
MAY	1893
AUGUST	1893
SEPTEMBER	1893
OCTOBER	1893
NOVEMBER	1893
JANUARY	1894
MAY	1894
JULY	1894
JANUARY	1895
MAY	1895

We will extend the subscription term of any of our subscribers copy for copy. That is, for each one of these issues we will add one issue to the subscriber's term. If you do not bind the magazine, look over your numbers on hand and send to us any of them here listed, and we shall be greatly obliged to you.

considerable saving in wear of pulleys and sheaves is effected by their smooth surface.

The Ingersoll-Sergeant Drill Company has issued a very attractive illustrated booklet bearing the title "Number 25,000." The significance of this title is very easily understood, and it forms in itself a remarkable tribute to the sucess and prosperity of the company. All of the rock drills made by the company bear a serial number, of which a complete record is kept. A short time ago the twenty-five thousandth machine was finished. As the booklet says, "it is hard to realize what is implied in this small statement of fact." The drills have found their way all over the globe, but if they were assembled together at the equator and placed one mile apart they would circle the earth. At an average weight of 900 pounds per outfit the works have turned out 22,500,000 pounds of rock drills alone. The combined capacity of all of these drills would be 2,000,000 lineal feet or 375 miles of hole per day. This would equal a hole through the earth in twenty-one days.

The Trenton Iron Company has issued an illustrated book, attractively bound in yellow buckram devoted to "Cable Hoist-Conveyors." The book describes the Laurent-Cherry patent system in which no fall-rope carriers are required and the Hall patent cable-hoist conveyor, with self-filling buckets for excavating. Inclined cable-hoist conveyors have been used for a long time with excellent results in the quarries of Pennsylvania and Vermont, and also for quarry work in other locations. The distinguishing feature of the Laurent-Cherry system is absence of all-rope carriers, that have been necessary heretofore on lines of this class for supporting the hoisting rope which would sag unduly when relieved of the tension due to the load, if not supported in some way. The merit of this system is that the expense of maintaining them is less, the wear and tear of the moving ropes is diminished and it becomes practicable to move the carriage at a much greater speed, so that the capacity to handle a certain amount of material in a given time, is correspondingly increased. The Hall patent hoist-conveyor is especially adapted to excavating canals and trenches, but may also be used to construct levees, and embankments, is susceptible of being easily dismantled and re-erected. The illustrations show a number of patterns of each of these systems that have been erected in various parts of the country. Any one who is interested in hoist-conveyors should ask for a copy of this book.

The New Albany Manufacturing Company has just shipped a pair of Knobel patent wire rip saws to the Phenix Stone & Lime Company, Phenix, Mo., and a single machine of the kind to Butler Ryan Company, of St. Paul, Minn. These wire saws have been given a thorough test in the Bedford region, and have demonstrated their value.

William H. Anderson & Sons, of Detroit, Mich., the long established and reliable manufacturers of tools and supplies for stone, marble and granite workers, are reaping the benefit of the general prosperity in all lines of stone industry. Their orders come not only from all parts of the United States, but from Canada as well, the company having made a recent shipment of a considerable amount of tools to British Columbia. The company reports that although last season was not the best it has had, still it showed a decided improvement over quite a few former years. Last season it worked up over 111,000 pounds of steel of various grades, costing as high as 45 cents per pound.

Steel Cores for Concrete

The results of an investigation by M. Considere to ascertain the value of metallic cores for strengthening mortar and concrete have recently been published. M. Considere, says the "Builder," has arrived at the conclusion that mortar armed with an iron core can undergo without rupture an elongation 20 times as great as would be possible without the aid of a core. Tests were made with various mortars and concretes, using prisms of square section 60 cm. long, 6 cm. in the side, in which were embedded rods or wires of iron. M. Considere is of opinion that injury to buildings by the settling of foundations, unequal expansions and shocks is much less liable to occur when cores are used, and finds that wrought iron and hard steel of the kind used for rails is capable of strengthening mortar and concrete to a much greater extent than is the iron usually employed for cores.

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Seattle, Wash., April 15, 1899.

The State million and half dollar water supply contract is about to be let. The Regents of the University of Washington, at a recent meeting, decided to ask local architects to submit plans for two new dormitories, upon the condition of receiving $600 for the accepted plans, the same to be submitted on April 21. The sum of $50,000 is appropriated for the buildings. The secretary of the United States Treasury is asking proposals for a postoffice site to be opened soon. Gov. Rogers has vetoed the capitol building bill.

F. J. W.

Fort Worth, Texas, April 15, 1899.

The state of the stone trade in this city is fairly satisfactory, better than it has been for a number of years past. The local demand for stone is only normal, but the trade is benefitted by the improvements being done by the Texas & Pacific Railroad Company. They are building two passenger stations, a thirty-six stall roundhouse and a machine shop. The passenger station has one story of red Pecos stone and the balance of the building is of brick with stone trimmings. There is very little cut stone in the roundhouse and shops, but quite a lot of masonry work. It seems to be the prevailing idea down here that stone hurts the appearance of a building. There have been three different jobs let here this spring. When the bids were opened they were found too high and the architects were instructed to go over the plans and specifications. The first thing the blue pencil went through was the cut stone. The Telephone Exchange building had a nice lot of Bedford stone trimmings in it, and out came the stone. A nice residence was also treated the same way. The bids for the Santa Fe Railroad Company's passenger station were opened and rejected as too high. I do not know when they will ask for bids again. It is rumored that they will not build, but go into *the Texas* & Pacific depot when it is finished. There is some talk of new courthouses at Waco and Houston, but I can not say how true the reports are. Both cities need such buildings badly. The Pecos Red Sandstone Company are very busy this season, being behind their orders. They have the largest soft stone quarry in the State. In fact, it is the only quarry where a stone of any size except granite can be got. Quite a little building is going on in Austin. The Southwestern Telephone Company there is erecting an exchange building of granite and sandstone. The company is building fine exchages in all the large cities of Texas.

GOWEN.

Terre Haute, Ind., May 7, 1899.

Since my last report business has been moving briskly, especially in the building trades. Quite a number of new buildings are under way at the present time, and the monumental shops, of which there are a number in town, are all busy. Another new monumental works has been opened by Joe Kirchner, a competent stonecutter. The Terre Haute Stone Works Company are very busy at present, and report every prospect favorable. They are now erecting a fine porch for a residence in Hoopeston, Ill., of Bedford buff stone which was dressed here. During the past week the company began work on the new church in Paris, Ill., to be built wholly of Bedford buff stone. During the past month the company has secured the stone work on a new church of the same material for Nokomis, Ill. This is a job of trimmings and is full of rich work. There is also a report that a valuable business corner on the Main street, which was swept by fire last fall, will be adorned with a new building. It was formerly occupied by a large department store.

The town is talking of little except the deal by which the Russell Harrison street railway, electric lighting, and steam heating plants will pass to the ownership of a syndicate of Boston capitalists. The syndicate has secured option on $400,000 first mortgage bonds at par on perhaps $300,000 of the $542,000 of second mortgage bonds.

TERRE HAUTE.

Cleveland, O., May 5, 1899.

The building boom has struck this city in earnest. There is now more work than

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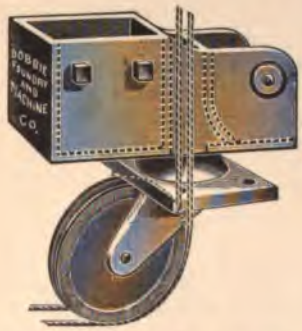

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there has been since the spring of 1893. Bricklayers are in great demand, and are even being offered, in some instances, $4 a day or 50 cents an hour. All the building trades of Cleveland are working the full eight-hour day, with the exception of a very small number of carpenters, commonly known as hammer and saw men, and unskilled and unapprenticed carpenters. There are at least fifteen modern-equipped apartment houses in the course of erection, or for which ground has been broken, ranging in price from $20,000 to $60,000 each. These are all in the fashionable residential portion of the city. They are chiefly of pressed brick with stone or terra cotta trimmings. The largest job going on at present for stonecutters is the brick residence of Mr. August Kuntz. It is of pressed brick with elaborate stone trimmings, will cost $75,000, and employs twenty cutters. Mr. Severence is erecting a $45,000 residence of pressed brick with stone trimmings. The Rockefeller kindergarten of the same material is also in course of erection.

D. GWILYM GEORGE.

Sault Ste Marie, May 8, 1899.

There is little doing just at present among the stone men. Contracts will be let this month for a new school to cost $20,000 and for one small business block to cost $7000. Both of these are to be built of brick with brownstone trimmings. The Lake Superior Water Power Canal was opened the 1st of May, but there is no stone work started on it yet.

H. M.

Percolation Through Brick and Stone "vs. Asphaltum."

To the Editor of "Stone."

Peradventure we noticed a paragraph on page 223 of your April number of "Stone" relating to "percolation through brick and stone," and we take the liberty of relating our experience in this direction.

We have never found that water could be absolutely excluded from a space enclosed by brick or stone, even when the outer surfaces were finished with Portland cement.

This is more particularly the case in subterranean vaults or conduits, and the greater the depth the greater the hydrostatic pressure and consequently the more rapid is the percolation.

The only method of absolutely preventing this is by covering the outer surface of walls with a coating of pure asphalt, especially made for this purpose. We have used this successfully, where everything else had failed. Yours truly,

ASSYRIAN ASPHALT CO.,
J. F. HILL, Secretary-Treasurer.

Chicago, Ill., April 24, 1899.

Book Reviews.

ANNUAL REPORT OF THE SMITHSONIAN INSTITUTION FOR 1897. Washington, Government Printing Office.

This attractive report is of more general interest than most of the government publications. The present volume is rich in suggestive and valuable papers on scientific subjects of moment. Of practical interest to the readers of "Stone" are the following papers: "The Discovery of New Elements Within the Last Twenty-five Years," by Clemens Winkler; "The Age of the Earth as an Abode Fit for Living," by Lord Kelvin; "Rising of the Land Around Hudson Bay," by Robert Bell; "Crater Lake, Oregon," by J. L. Diller; "A New Group of Stone Implements From the Southern Shores of Lake Michigan," by W. A. Phillips; "A Preliminary Account of Archaeological Field Work in Arizona in 1897," by J. Walter Fenkes, and "The Building for the Library of Congress." The volume is profusely illustrated and includes a number of excellent colored lithographs.

IRON-MAKING IN ALABAMA. By William Battle Phillips, Ph. D., Montgomery, Ala. Roemer Printing Company, State Printers.

The second edition of this excellent report has been issued. It is a very thorough and accurate study of the subject, reinforced with carefully compiled tables of statistics. It makes a volume of nearly 400 pages and is creditable to the author in its thoroughness of treatment.

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Advertisements under this heading inserted for subscribers to STONE *free of charge. Advertiser must send 25 cents to pay postage, if replies are to be addressed in care of* STONE. *Rate to non-subscribers, 10 cents a line each insertion.*

BY a thoroughly competent Draughtsman and Stonecutter; can handle any problem in stone-cutting from inception to completion, including draughting, template and pattern making and getting the work out at the banker, turning out work rapidly and accurately; thoroughly posted on plans, etc.; many years' experience as foreman; can handle men and stock to best advantage; references the best. Address E. W. HIND, 200 Orange street, Newark, N. J.

WANTED.—Good second-hand channeller. Address V., care of STONE.

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Advertisements inserted in this department for 15 cents a line each insertion.

FOR SALE OR LEASE—A fully equipped stone-yard at West Superior, with everything ready for business—dockage, switchage and paved street. Outlook for business never better. A fine opportunity. For particulars address ADAMANT MANUFACTURING CO., West Superior, Wis., Milwaukee, Wis.

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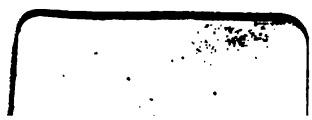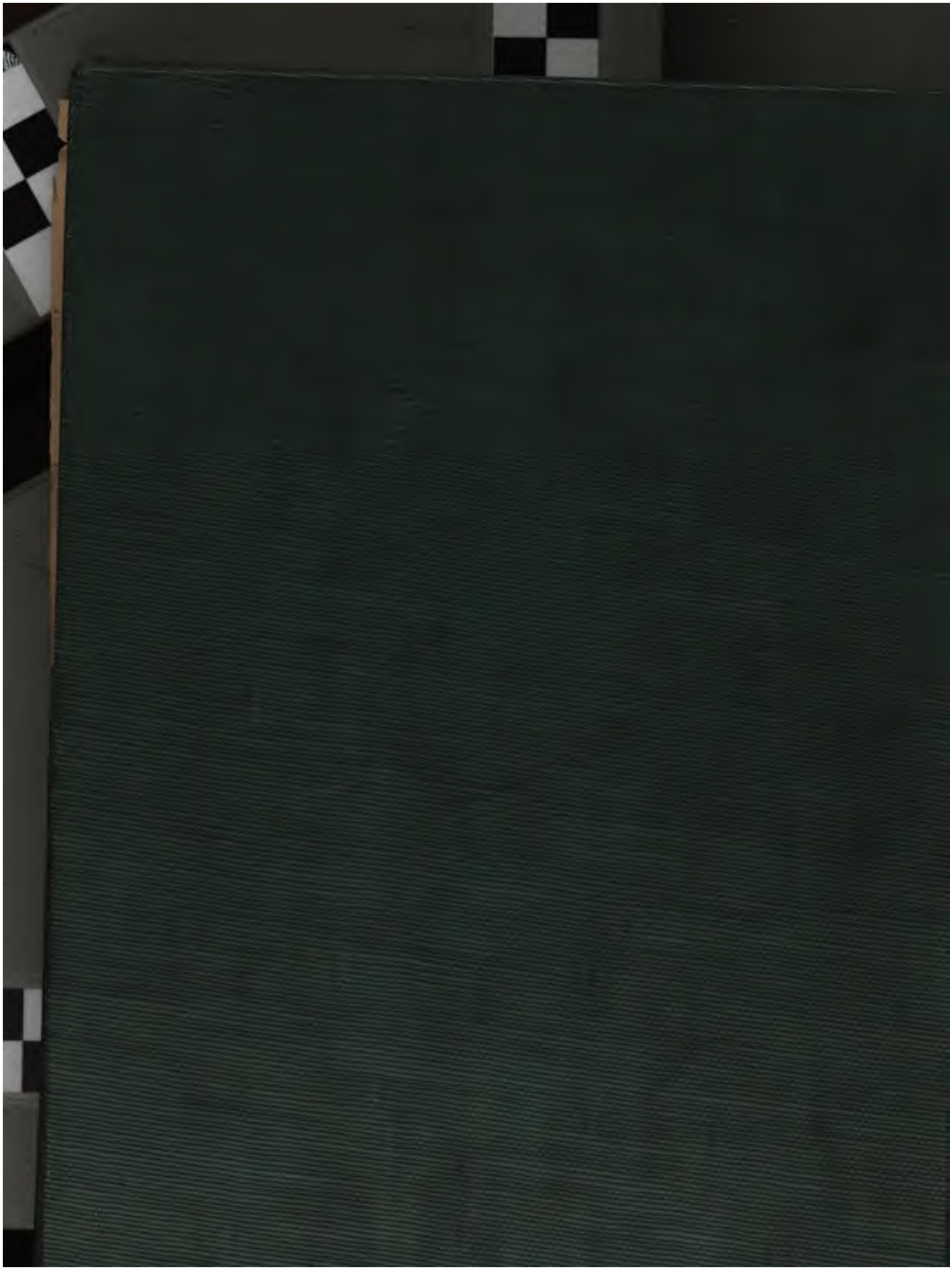
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